Inventorization of Marchantiophyta in Barail Wildlife Sanctuary, Assam, India with special reference to their microhabitat

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Abstract: ***Das, S. & Sharma, G. D. (2013): Inventorization of Marchantiophyta in Barail Wildlife Sanctuary, Assam, India with special reference to their microhabitat.***
Barail Wildlife Sanctuary (BWS) lies amidst the tropical forests of the state Assam, India between the coordinates 24°58' – 25°5' North latitudes and 92°46' – 92°52' East longitudes. It covers an area of about 326.24 sq. km. with the altitude ranging from 100 – 1850 m. An ongoing study on the group Marchantiophyta (liverworts, bryophyta) of BWS reveals the presence of 42 species belonging to 24 genera and 14 families. Among these, one genus (*Conocephalum* Hill) and 13 species are recorded as new for the state of Assam, eight species have been found which are endemic to India, seven species are recorded as rare and one species, *Heteroscyphus pandei* S.C. Srivast. & Abha Srivast. as threatened within the study area. Out of 24 genera identified, 46% have been found growing purely as terrestrials, 25% as purely epiphytes and 29% have been found to grow both as terrestrials as well as epiphytes. Among these, a diverse and interesting range of microhabitats have also been observed for each taxon. It has been found that genera having vast range of microhabitats comprise large percentage of the total liverwort flora of BWS.

1. Introduction

Barail Wildlife Sanctuary (BWS) (Fig. 1) is situated amidst the virgin tropical forests and undulating hillocks of Southern Assam, India between the coordinates 24°58' – 25°5' North latitudes and 92°46' – 92°52' East longitudes. It covers an area of about 326.24 sq. km. and has been identified as one of the eco-climatic reservoirs of Liverworts in India (Das & Sharma, 2012). The sanctuary enjoys tropical humid climate with average annual rainfall of 3383.5 mm. Monsoon starts from late May and continues up to October. Moreover, there is a prolonged pre-monsoon with heavy showers during mid-March to April. Mean maximum and minimum temperature are 35^0c and 5^0c respectively. Average humidity is 78%. Soil is sandy-loamy and sandy-clayey. The varied topography has profound influence on the climate of the sanctuary which varies with

elevation and location. Variable eco-climatic conditions with vast range of altitudinal variations starting from less than 100 m to more than 1850 m (Anonymous, 2006), unique geographical position and high precipitation have made the area one of the richest treasure houses of bryofloral wealth in the country including diverse species of Marchantiophyta (liverworts).

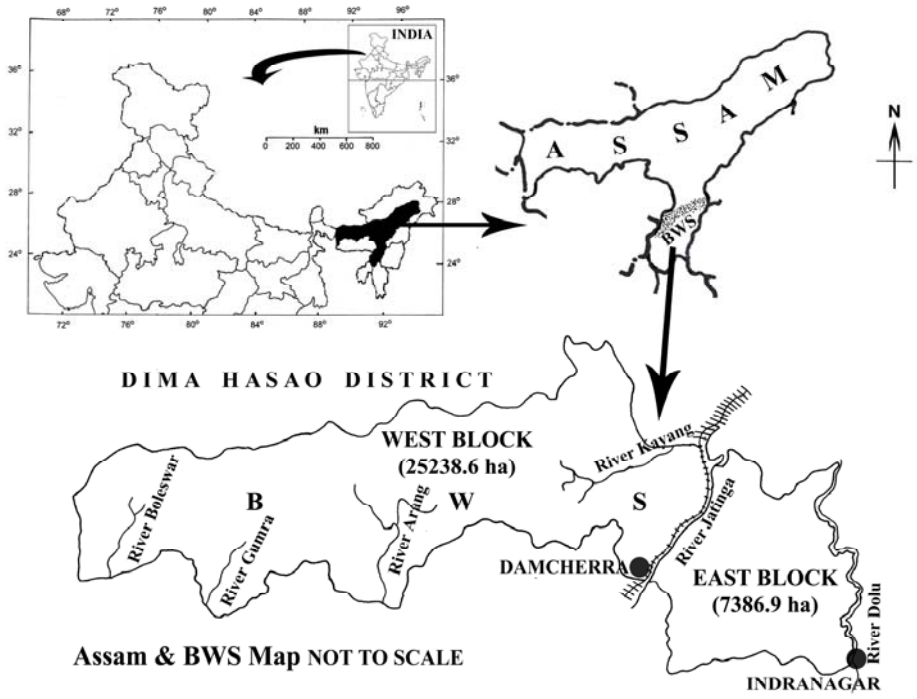

Fig. 1. Location Map of Barail Wildlife Sanctuary

No comprehensive reports are available on the bryofloral diversity of the sanctuary. Only recently, Barbhuiya & Singh (2012) made a fragmentary report of liverworts & Hornworts from the sanctuary. But, records of *Heteroscyphus argutus* (Reinw. *et al*.) Schiffn., *Lejeunea tuberculosa* Steph. and *Lopholejeunea sikkimensis* Steph. by them as new for the state of Assam are erroneous. *Heteroscyphus argutus* was earlier reported from Assam as *Chiloscyphus argutus* (Reinw. *et al.*) Nees by Barukial (2011). Singh *et al*. (2010) mentioned the state Assam as one of the distribution sites for *Lejeunea tuberculosa* and *Lopholejeunea sikkimensis*. The latter was treated as a synonym of *Lopholejeunea nigricans* (Lindenb.) Schiffn. both by Singh *et al*. (2010) and Zhu & Gradstein (2005).

The present communication, being a part of an ongoing study on the group Marchantiophyta of BWS, provides an up to date nomenclature of the taxa identified with their proper distribution in and outside the country, an user-friendly identification manual and range of microhabitats for all the species within the sanctuary.

2. Forest Components

BWS has variable picturesque habitats of evergreen and semi-evergreen forests. Dominant floral composition of the sanctuary are different species of *Ficus*, *Terminalia ballerica*, *T. myriocarpa*, *Mangifera indica*, *Artocarpus chaplasha*, *Magnolia* sp., *Dipterocarpus* sp., *Gmelina arborea*, *Anthocephalus* sp., etc. and many types of bamboos like *Bambusa balcooa*, *B. tulda*, *Dendrocalamus hamiltonii*, etc. Among these, *Ficus* sp., *Terminalia* sp., *Mangifera indica*, *Artocarpus chaplasha* etc. support luxuriant growth of epiphytic liverworts.

3. Materials and Methods

This observation is based on survey, collection and observation of Marchantiophyta from different eco-regions of the sanctuary during 2011 – 2012. The specimens are housed in the herbarium of Assam University, Silchar, India. Identification of the specimens has been done following conventional methods of taxonomic study and also with the help of protologues, monographs and floras (Sharma & Srivastava, 1993, Zhu & So, 2001, Srivastava & Srivastava, 2002, Rawat & Srivastava, 2007, etc.). An elaborate key has been provided for the orders, families, genera and species for easy identification of the taxa.

4. Results

A total of 42 species distributed under 24 genera, 14 families and three orders have been identified yet from the study area. Among these, Lejeuneaceae Casares-Gil has been found as the largest family (with eight genera) and *Heteroscyphus* Schiffn., as the largest genus (with five species) within the sanctuary. Among the total taxa identified, one genus, *Conocephalum* Hill and 13 species belonging to different genera have been found new for the state of Assam. Eight species, which are endemic to India have also been recorded from the sanctuary. Till date, seven species have been found as rare and one species as threatened (Das & Sharma, 2012) within the study area.

An account of the orders, families and genera identified yet from the study area has been given in the following table along with the number of species under each genus and their range of habitats (Table I).

Orders	Family	Genus	Number of species	Habitat	
				Terrestrial	Epiphytic
Jungermanni-ales	Lepidoziaceae	*Bazzania* Gray	2	√	–
	Cephaloziaceae	*Cephalozia* Dumort.	1	√	–
	Jungermanni-aceae	*Solenostoma* Mitt.	2	√	–
	Geocalycaceae	*Chiloscyphus* Corda	1	√	–
		Heteroscyphus Schiffn.	5	√	√
	Plagiochilaceae	*Plagiochila* (Dumort.) Dumort.	4	√	√
	Radulaceae	*Radula* Dumort.	2	√	√
	Frullaniaceae	*Frullania* Raddi	2	√	√
	Lejeuneaceae	*Archilejeunea* (Spruce) Schiffn.	1	–	√

		Cheilolejeunea (Spruce) Schiffn.	1	–	√
		Cololejeunea (Spruce) Schiffn.	3	–	√
		Lejeunea Lib.	1	–	√
		Leptolejeunea (Spruce) Schiffn.	1	-	√
		Lopholejeunea (Spruce) Schiffn.	2	√	√
		Microlejeunea Steph.	1	√	√
		Trocholejeunea Schiffn.	1	–	√
Metzgeriales	Pallaviciniaceae	*Pallavicinia* Gray	2	√	√
	Aneuraceae	*Aneura* Dumort.	1	√	–
		Riccardia Gray	2	√	–
Marchanti-ales	Cyathodiaceae	*Cyathodium* Kunze	1	√	–
	Conocephal-aceae	*Conocephalum* Hill[§]	2	√	–
	Marchantiaceae	*Dumortiera* Nees	1	√	–
		Marchantia L.	2	√	–
	Ricciaceae	*Riccia* L.	1	√	–
Total: 3	**14**	**24**	**42**		

§ Genus New to Assam

Table I: Account of the orders, families and genera in Barail Wildlife Sanctuary

5. Key to the orders, families, genera and species

1a. Plants always differentiated into stem and leaves……...…2. Jungermanniales
1b. Plants thalloid……...……..31
2a. Leaves simple……..…3
2b. Leaves complicate bilobed……...……..17
3a. Leaves incubous ……...4. *Bazzania* (Lepidoziaceae)
3b. Leaves succubous……..……...5
4a.Underleaves distant, quadrate to subquadrate…….....*B. sumbavensis*
4b. Underleaves overlapping at base, rectangulate to obovate…….....*B. tridens*
5a. Underleaf absent or very much reduced ……..……6
5b. Underleaf always present…….....9. Geocalycaceae
6a. Leaves 2 lobed…….……....*Cephalozia pandei* (Cephaloziaceae)
6b. Leaves unlobed……..……..……7
7a Leaf margin entire, perianth mouth narrowed……...8. *Solenostoma* (Jungermanniaceae)
7b Leaf margin toothed or rarely entire, perianth mouth wide…...14. *Plagiochila* (Plagiochilaceae)
8a. Stem cells differentiated…….…….....*S. purpuratum*
8b. Stem cells undifferentiated……..…….....*S. tetragonum*
9a.Underleaves always free…….....*Chiloscyphus campanulatus*
9b.Underleaves connate broadly to narrowly with adjoining leaves at their bases, rarely free…….....10. *Heteroscyphus*
10a.Leaves broadest at middle…….....*H. orbiculatus*
10b. Leaves broadest at base……..……1

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11a. Leaves 3-4-dentate……...*H. pandei*
11b. Leaves 2-10-dentate……...12
12a. Dentitions many, 2-9 cells long ……..*H. argutus*
12b. Dentitions few, shorter, 1-4 cells long……...……13
13a. Leaves as long as broad or broader than long……...*H. hyalinus*
13b. Leaves always longer than broad……...*H. palniensis*
14a. Underleaves present……...15
14b. Underleaves absent……..16
15a.Vitta cells absent in leaf……..*P. parvifolia*
15b. Vitta cells present in leaf……...*P. perserrata*
16a. Leaves distant, entire……...…*P. retusa*
16b. Leaves imbricate, 10 – 12-dentate ……...……..*P. grollei*
17a. Leaf lobule galeate, helmet shaped of lanceolate…….....20 *Frullania* (Frullaniaceae)
17b. Leaf lobules saccate or triangular – sub-rhimboidal……..18
18a. Lefa lobules triangular or sub-rhomboidal……..…….....19. *Radula* (Radulaceae)
18b. Leaf lobules saccate or rarely explanate……...…...21. Lejeuneaceae
19a. Stem 5-cells across diameter; gemmae present……..……*R. assamica*
19b. Stem 9 – 10 x 6 – 7 cells across diameter; gemmae absent……...*R. obscura*
20a. Leaf lobules both lanceolate and cucullate; underleaves squarrose……..…*F. ericoides*
20b. Leaf lobules only cucullate; underleaves squarrose to reniform..……..*F. muscicola*
21a.Underleaves absent……..……....22.*Cololejeunea*
21b.Underleaves present……...……..….24
22a. Leaf lobules explanate……..……..*C. furcilobulata*
22b. Leaf lobules saccate……...……..……23
23a.Leaf lobes ovate-elliptic; cuticle weakly papillose……...……..*C.trichomanis*
23b.Leaf lobes oblong; cuticle smooth……..……..*C. siangensis*
24a. Underleaves entire……..…….25
24b. Underleaves bidentate……...…28
25a. Plants with blackish pigmentation in leaf cells……..……..26. *Lopholejeunea*
25b. Plants without blackish pigmentation in leaf cells..……..……...27
26a. Stem in cross section with 12 – 15 medullary cells……...*L. subfusca*
26b. Stem in cross section with 20 – 22 medullary cells……..….*L. nigricans*
27a. Stem cells thick-walled with distinct trigones…..……..……...*Archilejeunea minutilobula*
27b.Stem cells thin-walled without any distinct trigones.……...……..*Trocholejeunea infuscata*
28a.Ocelli present in leaf cell…….....*Leptolejeunea elliptica*
28b. Ocelli absent in leaf cell…….....29
29a. Plants minute, 0 .20 – 0.25 mm wide.……...…….....*Microlejeunea punctiformis*
29b. Plants medium in size, 1.0 – 2.0 mm wide……...…30
30a. First tooth of leaf lobule larger than second tooth……..*Lejeunea obscura*
30b. First tooth of leaf lobule smaller than second tooth…….....*Cheilolejeunea subopaca*
31a.Thallus without air pores and air chambers; upper chlorophyllous layer not clearly differentiated……..……..……..…....32. Metzgeriales
31b. Thallus with or without air pores and air chambers; upper chlorophyllous layer containing photosynthetic filaments or rarely empyt……..…….……..…..36. Marchantiales
32a. Plants with distinct midrib; lamina unistratose…….....33. *Pallavicinia* (Pallaviciniaceae)
32b. Plants without distinct midrib; lamina multistratose……...…...34. Aneuraceae
33a. Plants yellowish to brownish green; median cells of wing larger, *ca* 120 x56 µm; midrib 0.5 – 1.5 mm thick……..……...……....*P. ambigua*
33b. Plants green or pale green; median cells of wing smaller, *ca* 54 x 40 µm; midrib 0.5 mm thick…….....*P. lyellii*

34a.Thallus broad, rarely branched …….…….....*Aneura maxima*
34b. Thallus narrow, profusely branched…….....…..……..35. *Riccardia*
35a. Plants minute, 2 – 5 mm long, 0.30 – 0.35 mm wide……...*R. tenuicostata*
35b. Plants larger, 10 – 25 mm long, 0.5 – 1.5 mm wide……..……....*R. multifida*
36a. Sporophyte arising from ventral surface of thallus; completely embedded in thallus…….....*Riccia frostii* (Ricciaceae)
36b. Sporophyte arising from dorsal surface of thallus, not embedded in thallus……..…….....37
37a. Air chambers present, empty……..…...*Cyathodium aureonitens* (Cyathodiaceae)
37b.Air chambers present or absent; when present, filled with assimilatory filaments……...38
38a. Air pores always present, simple; terminal cells of assimilatory filaments beaked……...……..……....39. *Conocephalum* (Conocephalaceae)
38b. Air pores present or absent, when present, compound, barrel shaped; terminal cells of assimilatory filaments, where present, not beaked...…….…….....40. Marchantiaceae
39a. Plants not branched at apex; gemmae absent…….....*C. conicum*
39b. Plants freely branched at apex, bearing gemmae……....*C. japonicum*
40b. Air chambers vestigial or absent; dorsal pores absent…….....*Dumortiera hirsuta*
40b. Air chamber well developed; dorsal pores prominent, compound, barrel-shaped……..41. *Marchantia*
41a. Appendage of ventral scales oblong-ovate……..…….....*M. linearis*
41b. Appendage of ventral scales lanceolate…….....*M. subintegra*

6. Enumeration of Taxa

Jungermanniales H. Klinggr.
Lepidoziaceae Limpr.

Bazzania sumbavensis (Gottsche *ex* Steph.) Steph. in Hedwigia 32: 204. 1893; Mizut. In J. Hattori. Bot. Lab. 30:77. 1967; D. Sharma & S.C. Srivast. in Bryophyt. Biblioth. 47:107. 1993; Sudipa Das & G.D. Sharma in Assam Univ. J. Sc. Tech. 10: 13. 2012. *Mastigobryum sumbavense* Gottsche ex Steph. in Hedwigia 25: 236. 1886.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, 25 km away from Kumbirgram, *ca* 70 m, 23.01.2012, *S. Das* 25009; from the bank of the river Jatinga at Marwacherra, *ca* 50 m, 11.03.2012, *S. Das* 25022; from the bank of the river Boleswar at Malidar, *ca* 70 m 15.04.2012, *S. Das* 25042 (Assam University Herbarium).

Distribution: India [Eastern Himalaya (Assam, Meghalaya, Sikkim, West Bengal)], Nepal, Java, New Guinea, Sumatra, Sumbava (Sharma & Srivastava, 1993; Pradhan & Joshi, 2009; Das & Sharma, 2012a).

Note: In this ongoing study on the group Marchantiophyta of Barail Wildlife Sanctuary, *B. sumbavensis* has been recorded for the first time from the state of Assam (Das & Sharma, 2012). The species is common in the sanctuary.

Bazzania tridens (Reinw., Blume & Nees) Trev., Mem. R. Instit. Lombardo ser. 3, 4: 415. 1877; D. Sharma & S.C. Srivast. in Bryophyt. Biblioth. 47: 121. 1993. *Jungermannia tridens* Reinw., Blume & Nees, Nova Acta Acad. Caes. Leop. Carol. 12: 228. 1824. *Mastigobryum tridens* (Reinw.,Blume & Nees) Nees in Syn. hepat. 227. 1845. *Mastigobryum oblongum* Mitt. in J. Proc. Linn. Soc. Bot. 5: 106. 1861.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, 25 km away from Kumbirgram, *ca* 70 m, 23. 01.2012, *S. Das* 25006 (Assam University Herbarium).

*Distribution:*India [Eastern Himalaya (Arunachal Pradesh, Assam, Meghalaya, Sikkim, West Bengal), Western Ghats (Tamil Nadu)], Sri Lanka, Bhutan, China, Japan, Philippines,

Thailand, Indonesia, Korea, Myanmar, Samoa, Taiwan, Vietnam (Sharma & Srivastava, 1993; Das, 2009).

Cephaloziaceae Mig.

*#***Cephalozia pandei** Udar & D. Kumar in Geophytology 6: 35. 1976

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, from the bank of the river Boleswar at Malidar, *ca* 70 m, 15.04.2012, *S. Das* 25036a (Assam University Herbarium).

Distribution: India: [Eastern Himalaya (Arunachal Pradesh, Assam - present study, Meghalaya, West Bengal)], endemic to India (Udar & Kumar, 1976; Singh *et al.*, 2003; Das, 2009).

Note: The present ongoing study records *C. pandei* for the first time from the state of Assam. Earlier, in India, it was known from Arunachal Pradesh, Meghalaya and West Bengal.

Jungermanniaceae Rchb.

Solenostoma purpuratum (Mitt.) Steph., Sp. Hepat. 2: 51. 1901; Váňa & Long in Nova Hedwigia 89: 506. 2009. *Jungermannia purpurata* Mitt. in J. Proc. Linn. Soc. Bot. 5: 91. 1861.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, Damcherra, *ca* 200 m, 11.03.2012, *S. Das* 25029 (Assam University Herbarium).

Distribution: India [Eastern Himalaya (Arunachal Pradesh, Assam, Meghalaya, Sikkim, West Bengl), Western Himalaya (Himachal Pradesh)], Nepal, China (Amakawa, 1967; Das, 2009; Váňa & Long, 2009).

Solenostoma tetragonum (Lindenb.) R.M. Schust. *ex* Váňa *et* D.G. Long in Nova Hedwigia 89: 509. 2009. *Jungermannia tetragona* Lindenb., Bot. Zeit. (Berlin) 6: 462. 1848.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, Malidar, *ca* 70 m, 15.04.2012, *S. Das* 25036 (Assam University Herbarium).

Distribution: India [Eastern Himalaya (Arunachal Pradesh, Assam, Meghalaya, Sikkim, West Bengal), Western Himalaya (Uttarakhand)], Bhutan, China (Singh & Nath, 2007; Váňa & Long, 2009; Das, 2009; Singh & Barbhuiya, 2012).

Geocalycaceae H. Klinggr.

*#***Chiloscyphus campanulatus** Steph., Sp. Hepat. 3: 208. 1906; Abha Srivast. & S.C. Srivast., Indian Geocalycaceae: 44. 2002; Das Bhattacharyya *et al*., Current Sc. 101 (7):825. 2011.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, 25 km away from Kumbirgram, *ca* 70 m, 23. 01. 2012, *S. Das* 25008; Marwacherra, *ca* 50 m, 06.05.12, *S. Das* 25051a (Assam University Herbarium).

Distribution: India [Eastern Himalaya (Assam), Western Himalaya (Jammu & Kashmir, Himachal Pradesh, Uttarakhand)], endemic to India (Srivastava & Srivastava, 2002; Singh & Singh, 2009; Das Bhattacharyya *et al*., 2011).

Heteroscyphus argutus (Reinw. *et al*.) Schiffn., Oesterr. Bot. Zeitschr., 60: 172. 1910; Abha Srivast. & S.C. Srivast., Indian Geocalycaceae : 122. 2002. *Jungermannia arguta* Reinw. *et al*., Hep. Javan. 206. 1824.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, Damcherra, *ca* 200 m, 11.03.2012, *S. Das* 25029a; from the bank of the river Boleswar at Malidar, *ca* 70 m 15.04.2012, *S. Das* 25032a, 25041a (Assam University Herbarium).

Distribution: India [Eastern Himalaya (Arunachal Pradesh, Assam, Manipur, Meghalaya, Sikkim, West Bengal), Western Himalaya (Himachal Pradesh, Uttarakhand), Western Ghats (Karnataka, Kerala, Tamil Nadu), Central India (Madhya Pradesh)], Nepal, China, Japan, New Guinea, Indonesia, Australia (Srivastava & Srivastava, 2002; Das, 2009).

Heteroscyphus hyalinus (Steph.) Abha Srivast. & S.C. Srivast., Indian Geocalycaceae: 118. 2002. *Lophocolea hyalina* Steph. in Soc. Roy. Belg. 38: 254. 1899.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, from the bank of the river Boleswar at Malidar, *ca* 70 m, 15.04.2012, *S. Das* 25032b, 25041b, 25042a (Assam University Herbarium).

*Distribution:*India: [Eastern Himalaya (Arunachal Pradesh, Assam, Sikkim, West Bengal)] Nepal (Srivastava & Srivastava, 2002; Das, 2009; Singh & Barbhuiya, 2012).

*#***Heteroscyphus orbiculatus** Abha Srivast. & S.C. Srivast., Indian Geocalycaceae: 140. 2002; Sushil K. Singh & D.K. Singh in Indian J. Forest.26: 317. 2003.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, from the bank of the river Boleswar at Malidar, *ca* 70 m, 15.04.2012, *S. Das* 25041 (Assam University Herbarium).

*Distribution:*India: [Eastern Himalaya (Arunachal Pradesh, Assam - present study), Western Himalaya (Himachal Pradesh), Western Ghats (Tamil Nadu)], endemic to India (Srivastava & Srivastava, 2002; Singh & Singh, 2003a; Das, 2009).

Note: The present ongoing study records *H. orbiculatus* for the first time from the state of Assam. Earlier, in India, it was known from Arunachal Pradesh, Himachal Pradesh and Tamil Nadu only. The species is rare in the sanctuary.

*#***Heteroscyphus palniensis** Abha Srivast. & S.C. Srivast., Indian Geocalycaceae: 130. 2002.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, Malidar, *ca* 80 m 15.04.2012, *S. Das* 25030 (Assam University Herbarium).

Distribution: India: [Eastern Himalaya (Assam, Sikkim), Western Ghats (Tamil Nadu)], endemic to India (Srivastava & Srivastava, 2002, Dey *et al*., 2009; Singh & Barbhuiya, 2012).

Heteroscyphus pandei S.C. Srivast. & Abha Srivast. in Lindbergia 15: 197. 1989; Abha Srivast. & S.C. Srivast., Indian Geocalyaceae: 134. 2002; Sudipa Das & G.D. Sharma in Assam Univ. J. Sc. Tech. 10: 13. 2012.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, from the bank of the river Jatinga at Marwacherra, *ca* 50 m, 11.03.2012, *S. Das* 25023 (Assam University Herbarium).

Distribution: India [Eastern Himalaya (Assam, Manipur, Sikkim, West Bengal), Western Himalaya (Himachal Pradesh, Uttarakhand)], Nepal (Srivastava & Srivastava, 2002; Singh & Singh, 2009; Singh *et al*., 2010; Das & Sharma, 2012a).

Note: In this ongoing study on the group Marchantiophyta of Barail Wildlife Sanctuary, *H. pandei* has been recorded for the first time from the state of Assam (Das & Sharma, 2012).In BWS, the species is found occurring in single locality only i.e. Marwacherra. *H. pandei* is rare and threatened in the sanctuary due to anthropogenic as well as natural threat factors (Das & Sharma, 2012a).

Plagiochilaceae (Joerg.) Müll.Frib. & Herzog

**Plagiochila grollei* Inoue, Bull. Nat. Sci. Mus., Tokyo 8(3): 384. 1965; M.L. So in Syst. Bot. Monogr. 60: 42.2001; K.K. Rawat & S.C. Srivast., Genus *Plagiochila* in Eastern Himalaya (india): 87. 2007. *P. zongiensis* Inoue, in Hara, Fl. E. Himalaya 1: 520. 1966.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, Marwacherra, *ca* 50 m, 06.05.2012, *S. Das* 25071 (Assam University Herbarium).

Distribution: India: [Eastern Himalaya (Assam - present study, West Bengal)], Bhutan, Nepal, China, Vietnam. (So, 2001; Rawat & Srivastava, 2007)

Note: The present ongoing study records *P. grollei* for the first time from the state of Assam. Earlier, in India, it was known from West Bengal only. The species is rare in the sanctuary.

Plagiochila parvifolia Lindenb. in Sp. hepat. (*Plagiochila* fasc.1): 28. 1839; M.L.So in Syst. Bot. Monogr. 60: 88. 90. 2001; K.K. Rawat & S.C. Srivast., Genus *Plagiochila* in Eastern Himalaya (India): 111. 2007; Sushil K. Singh & D.K.Singh in Cryptog. Bryol. 28: 259. 2007. *P. phalangea* Taylor in London J. Bot. 5: 264. 1846. *P. yokogurensis* Steph. in Bull. Herb. Boissier.5: 104. 1897. *P. cuspidata* Steph., Sp. hepat. 6: 144. 1918.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, from the bank of the river Boleswar at Malidar, *ca* 70 m, 15.04.2012, *S. Das* 25046a (Assam University Herbarium).

Distribution: India: [Eastern Himalaya (Arunachal Pradesh, Assam, Manipur, Meghalaya, Sikkim, West Bengal), Western Himalaya (Himachal Pradesh)], Bangladesh, Bhutan, Sri Lanka, China, Japan, Korea, Myanmar, Thailand, Vietnam, Philippines, Indonesia, Melanesia, New Guinea (So, 2001; Rawat & Srivastava, 2007; Das, 2009; Singh & Singh, 2009; Singh *et al*., 2010).

**Plagiochila perserrata* Herzog, in Handel-Mazzetti, Symb. Sin. 5: 19. 1903; M.L. So in Syst. Bot. Monogr. 60: 48. 2001; K.K. Rawat & S.C. Srivast., Genus *Plagiochila* in Eastern Himalaya (India): 83. 2007.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, from the bank of the river Boleswar at Malidar, *ca* 70 m, 15.04.2012, *S. Das* 25045, 25046 (Assam University Herbarium).

Distribution: India: [Eastern Himalaya (Assam - present study, Manipur)], Bhutan, China, Indonesia (So, 2001; Rawat & Srivastava, 2007).

Note: The present ongoing study records *P. perserrata* for the first time from the state of Assam. Earlier, in India, it was known from Manipur only.

Plagiochila retusa Mitt., J. Proc. Linn. Soc. Bot. 5, 1861; Inoue, Bull. Nat. Sci. Mus., Tokyo 8(3): 391. 1965; M.L.So in Syst. Bot. Monogr. 60: 126.2001; K.K. Rawat & S.C. Srivast., Genus *Plagiochila* in Eastern Himalaya (India): 126. 2007.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, Damcherra, *ca* 200 m, 11.03.2012, *S. Das* 25026 (Assam University Herbarium).

Distribution: India: [Eastern Himalaya (Assam, Sikkim) Western Himalaya (Uttaranchal)], Bhutan, China, (Mitten, 1861; So, 2001; Rawat & Srivastava, 2007)

Radulaceae (Dumort.) Müll. Frib.

Radula assamica Steph. in Hedwigia 23: 151, 1884; Yamada in J. Hattori Bot. Lab. 45: 288, 1979

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, 25 km away from Kumbirgram, *ca* 70 m, 23. 01.2012, *S. Das* 25009a (Assam University Herbarium).

Distribution: India: [Eastern Himalaya (Assam)], Sri Lanka, China, Myanmar, Thailand, Vietnam (Yamada, 1979; Zhu & So, 2001).

Radula obscura Mitt. in J. Proc. Linn. Soc. Bot. 5: 107. 1861; Yamada in J. Hattori Bot. Lab.45: 245. 1979; Udar & Dh. Kumar in Biol. Mem.9: 83. 1984.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, from the bank of the river Boleswar at Malidar, *ca* 70 m, 15.04.2012, *S. Das* 25038, 25039 (Assam University Herbarium).

Distribution: India: [Eastern Himalaya (Arunachal Pradesh, Assam, Meghalaya, West Bengal), Western Himalaya (Himachal Pradesh, Uttarakhand), Western Ghats (Tamil Nadu)] Nepal, China, Philippines, Thailand, Indonesia, Taiwan, Sri Lanka (Mitten, 1861; Yamada, 1979; Udar & Kumar, 1984; Das, 2009; Singh & Singh, 2009; Singh & Barbhuiya, 2012).

Frullaniaceae Lorch.

[*]***Frullania ericoides*** (Nees) Mont. in Ann. Sci. Nat., Bot., ser. 2, 12: 51. 1839; Sim Sim in Cryptog. Bryol. 20: 83. 1999; A.P. Singh *et al.* in Taiwania 53: 62. 2008; *Frullania squarrosa* (Reinw. *et al.*) Dumort., Recueil observ. Jungerm. 13. 1835. *Jungermannia eriocoides* Nees in Mastius Fl. Brasil.1: 346. 1833.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, Marwacherra, *ca* 50 m, 06.05.2012, *S. Das* 25068 (Assam University Herbarium).

Distribution: India: [Eastern Himalaya (Arunachal Pradesh, Assam - present study, Meghalaya, Manipur, West Bengal,), Western Himalaya (Himachal Pradesh, Uttarakhand), Western Ghats (Karnataka, Tamil Nadu,), Central India (Madhya Pradesh), Andaman & Nicobar Islands (Andaman Islands)], Nepal, Bhutan, China, Japan, Korea, Indonesia, Philippines, New Caledonia, Australia, Africa, North, Central and South America (Kamimura, 1961; Singh, 1996; Singh & Nath, 2007; Singh *et al*., 2008; Das, 2009; Singh & Singh, 2009; Singh *et al*., 2010).

Note: The present ongoing study records *F. ericoides* for the first time from the state of Assam. Earlier, in India, it was known from Arunachal Pradesh, Manipur, Meghalaya and West Bengal only. The species is common in the sanctuary.

Frullania muscicola Steph. in Hedwigia 33: 146. 1894; Kamimura in J. Hattori Bot. Lab. 24: 1. 1961; Narayan *et al.* in Indian J. Forest. 24: 275. 2001; A.P.Singh *et al.* in Taiwania 53: 70. 2008. *Frullania truncatifolia* Steph. *Ex* Yoshinaga in Bot. Mag. Tokyo 17: 38. 1903.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, Damcherra, *ca* 200 m, 11.03.2012, *S. Das* 25025; from the bank of the river Boleswar at Malidar, *ca* 70 m, 15.04.2012, *S. Das* 25037, 25038, 25039 (Assam University Herbarium).

Distribution: India: [Eastern Himalaya (Arunachal Pradesh, Assam, Manipur, Meghalaya, Sikkim), Western Himalaya. (Himachal Pradesh, Uttarakhand) Central India. (Madhya Pradesh) Western Ghats (Tamil Nadu)], Nepal, China, Japan, Korea, CIS (Kamimura, 1961; Singh, 1996; Das, 2009; Singh & Singh, 2009; Singh *et al*., 2010; Singh & Barbhuiya, 2012).

Lejeuneaceae Casares-Gil

[#]***Archilejeunea minutilobula*** Udar & U.S. Awasthi in Geophytology 11 (1): 72. 1981; Sudipa Das & D.K. Singh in Bull. Bot. Surv. India 49: 211. 2007.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, 25 km away from Kumbirgram, *ca* 70 m, 23. 01.2012, *S. Das* 25010a (Assam University Herbarium).

Distribution: India: [Eastern Himalaya (Arunachal Pradesh, Assam), Western Ghats (Maharashtra, Tamil Nadu,)], endemic to India (Udar & Awasthi, 1981; Das & Singh, 2007; Singh & Barbhuiya, 2012).

Cheilolejeunea subopaca (Mitt.) Mizut. in J. Hattori Bot. Lab. 26: 183. 1963. *Lejeunea subopaca* Mitt. in J. Proc. Linn. Soc., Bot. 5: 116. 1861.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, Marwacherra, *ca* 50 m, 06.05.2012, *S. Das* 25070a (Assam University Herbarium).

Distribution: India: [Eastern Himalaya (Assam, Meghalaya, Sikkim,West Bengal), Western Ghats (Kerala)], Nepal, China (Asthana *et al*., 1995; Zhu, 2006; Nair *et al*., 2008; Singh *et al*., 2008a; Singh & Barbhuiya, 2012).

#***Cololejeunea furcilobulata*** (Berrie & E.W. Jones) R.M. Schust. in Beih. Nova Hedwigia 9:178. 1963. *Leptocolea furcilobulata* Berrie & E.W. Jones in Trans. Brit. Bryol. Soc. 2: 417. 1954.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, Marwacherra, *ca* 50 m, 06.05.2012, *S. Das* 25070 (Assam University Herbarium).

Distribution: India [Eastern Himalaya (Assam), Western Ghats (Karnataka, Kerala, Tamil Nadu)], endemic to India (Asthana & Srivastava, 2003; Singh & Barbhuiya, 2012).

#***Cololejeunea siangensis*** G. Asthana & S.C. Srivast. in Bryophyt. Biblioth.60: 57.2003; Sudipa Das & G.D. Sharma in Assam Univ. J. Sc. Tech. 10: 13. 2012.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, 25 km away from Kumbirgram, *ca* 70 m, 23. 01.2012, *S. Das* 25001 (Assam University Herbarium).

Distribution: India [Eastern Himalaya (Arunachal Pradesh, Assam - present study)], endemic to India (Asthana & Srivastava, 2003; Das & Sharma, 2012a).

Note: In this ongoing study on the group Marchantiophyta of Barail Wildlife Sanctuary, *C. siangensis* been recorded for the first time from the state of Assam (Das & Sharma, 2012). Earlier, in India, it was known from Arunachal Pradesh only. The species is rare in the sanctuary.

Cololejeunea trichomanis (Gottsche) Steph. in Hedwigia 34: 252. 1895; G. Asthana & S.C. Srivast. n Bryophyt. Biblioth. 60: 54. 2003. *Lejeunea trichomanis* Gottsche in Abh. Naturw Ver. Bremen 7: 362. 1882.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, 25 km away from Kumbirgram, *ca* 70 m, 23. 01.2012, *S. Das* 25003, 25010 (Assam University Herbarium).

Distribution: India: [Eastern Himalaya (Arunachal Pradesh, Assam, Manipur, Sikkim, West Bengal), Western Ghats (Karnataka)], Nepal, China, Japan, Indonesia, Thailand, Philippines, Taiwan, Malaysia, Australia (Zhu & So, 2001; Asthana & Srivastava, 2003; Das, 2009; Singh *et al*., 2010; Singh & Barbhuiya, 2012).

*#***Lejeunea obscura*** Mitt. in J. Proc. Linn. Soc., Bot. 5: 112. 1861; R.L. Zhu & M.L. So in Beih. Nova Hedwigia 121: 139. 2001. *Hygrolejeune aobscura* (Mitt.) Steph., Sp. hepat. 5: 565. 1914. *Taxilejeunea obscura* (Mitt.) Eifrig in Ann. Bryol.9: 93.1937 "1936".

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, Marwacherra, *ca* 50 m, 06.05.2012, *S. Das* 25061a (Assam University Herbarium).

Distribution: India [Eastern Himalaya (Arunachal Pradesh, Assam - present study, Manipur, Sikkim, West Bengal)], Nepal, Bhutan, Sri Lanka, China, Indonesia (Mitten, 1861; Zhu & So, 2001; Das, 2009; Singh *et al*., 2010).

Note: The present ongoing study record Arunachal Pradesh, Manipur, Sikkim and West Bengal only. The species is common in the sanctuary.

Leptolejeunea elliptica (Lehm .& Lindenb.) Schiffn. In Engler & Prantl, Nat. Pflanzenfam. 1(3): 126. 1893; R.L. Zhu & M.L. So in Beih. Nova Hedwigia 121: 209. 2001. *Jungermannia elliptica*

Lehm. & Lindenb., Nov. strip. pug. 5: 13. 1833. *Leptolejeunea subacuta* Steph. ex A. Evans in Proc. Wash. Acad. Arts Sci. 8: 149. 1906.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, Marwacherra, *ca* 50 m, 06.05.2012, *S. Das* 25072 (Assam University Herbarium).

Distribution: India [Eastern Himalaya (Arunachal Pradesh, Assam, Manipur, Meghalaya, Sikkim, West Bengal), Western Ghats (Karnataka, Tamil Nadu), Andaman & Nicobar Islands (Andaman Islands)], Nepal, Bhutan, Sri Lanka, China, Japan, Indonesia, Philippines, Thailand, Australia, Africa, North America (Awasthi, 1986; Singh, 1996; Zhu & So, 2001; Yamada & Iwatsuki, 2006; Das, 2009; Singh *et al*., 2010; Singh & Barbhuiya, 2012).

Lopholejeunea nigricans (Lindenb.) Schiffn.inConsp. Hepat. Arch. Ind. 293. 1898; U.S. Awasthi *et al.* in Geophytology 29: 51. 2000. *Lejeunea nigricans* Lindenb. In Gottsche, Lindenb. & Nees, Syn. hepat.: 316. 1845.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, from the bank of the river Boleswar at Malidar, *ca* 70 m, 15.04.2012, *S. Das* 25037a (Assam University Herbarium).

Distribution: India: [Eastern Himalaya (Arunachal Pradesh, Assam, Manipur, Meghalaya, Sikkim), Western Ghats (Kerala)], China, Taiwan, Indonesia, Philippines,Thailand. (Awasthi *et al*., 2000; Singh *et al*., 2010; Singh & Barbhuiya, 2012).

****Lopholejeunea subfusca*** (Nees) Schiffn. In Hedwigia 29: 16. 1890; U.S. Awasthi *et al.* in Geophytology 29: 35. 2000. *Jungermannia subfusca* Nees in Hepat. Javan. 36. 1830.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, Marwacherra, *ca* 50 m, 06.05.2012, *S. Das* 25061, 25063a (Assam University Herbarium).

Distribution: India [Eastern Himalaya (Arunachal Pradesh, Assam - present study, Meghalaya, Sikkim, West Bengal), Western Ghats (Karnataka, Kerala, Tamil Nadu)], Sri Lanka, China, Taiwan, Japan, Indonesia, Philippines, Thailand, New Guinea, New Caledonia, Madagascar, Africa (Awasthi *et al*., 2000; Das, 2009).

Note: The present ongoing study records *L. subfusca* for the first time from the state of Assam. Earlier, in India, it was known from Arunachal Pradesh, Meghalaya, Sikkim and West Bengal of Eastern Himalaya and Karnataka, Kerala and Tamil Nadu of Western Ghats. The species is common in the sanctuary.

****Microlejeunea punctiformis*** (Taylor) Spruce in Steph., Sp. hepat. 5: 832. 1915; Verma & Srivastava in J. Bombay Nat. Hist. Soc. 108 (2): 120. 2011. *Lejeunea punctiformis* Taylor in London J. Bot. 5: 398. 1846.

Specimens examined:Assam, Cachar district, Barail Wildlife Sanctuary, Marwacherra, *ca* 50 m, 06.05.2012, *S. Das* 25061b, 25068a (Assam University Herbarium).

Distribution: India [Eastern Himalaya (Arunachal Pradesh, Assam - present study, Manipur, Sikkim, West Bengal), Western Ghats (Karnataka, Kerala, Tamil Nadu)], Nepal, Bhutan, Sri Lanka, China, Japan, Taiwan, Thailand, Vietnam (Mizutani, 1961; Zhu & So, 2001; Das, 2009; Singh *et al*., 2010 'as *Lejeunea punctiformis*'; Verma & Srivastava, 2011).

Note: The present ongoing study records *M. punctiformis* for the first time from the state of Assam. Earlier, in India, it was known from Arunachal Pradesh, Manipur, Sikkim and West Bengal of Eastern Himalaya and Karnataka, Kerala and Tamil Nadu of Western Ghats. The species is common in the sanctuary.

****Trocholejeunea infuscata*** (Mitt.) Verd.in Ann. Bryol. Suppl. 4: 190. 1934; S.Hatt. in Hara, Flora of Eastern Himalaya 533. 1966. *Lejeunea infuscata* Mitt. in J. Proc. Linn. Soc. Bot. 5: 111. 1861.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, Marwacherra, *ca* 50 m, 06.05.2012, *S. Das* 25067 ((Assam University Herbarium).

Distribution: India [Eastern Himalaya (Arunachal Pradesh, Assam - present study, Manipur, Meghalaya, Sikkim, West Bengal), Western Himalaya (Himachal Pradesh)], Sri Lanka, Nepal, Bhutan, China, Myanmar, Philippines, Thailand (Mitten, 1861; Awasthi & Srivastava, 1988; Singh & Singh, 2007; Singh *et al.*, 2008a; Das, 2009; Singh *et al*., 2010).

Note: The present ongoing study records *T. infuscata* for the first time from the state of Assam. Earlier, in India, it was known from Arunachal Pradesh, Manipur, Meghalaya, Sikkim and West Bengal of Eastern Himalaya and Himachal Pradesh of Western Himalaya. The species is rare in the sanctuary.

Metzgeriales R.M.Schust.
Pallaviciniaceae Mig.

#***Pallavicinia ambigua*** (Mitt.) Steph.in Sp. hepat. 1: 312.1902; Ghosh & Chakravarty in Sci. & Cult.8: 497. 1943. *Steetzia ambigua* Mitt. in J. Proc. Linn. Soc. Bot. 5: 123. 1861.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, 25 km away from Kumbirgram, *ca* 70 m, 23. 01.2012, *S. Das* 25018; from the bank of the river Boleswar at Malidar, *ca* 70 m, 15.04.2012, *S. Das* 25044; Marwacherra, *ca* 50 m, 06.05.2012, *S. Das* 25064 (Assam University Herbarium).

Distribution: India [Eastern Himalaya (Arunachal Pradesh, Assam), Western Ghats (Tamil Nadu)], endemic to India (Ghosh & Chakravarty, 1943; Bapna & Kachroo, 2000; Das, 2009).

Pallavicinia lyellii (Hook.) Carruth, Nat. Arr. Brit. Pl. 1: 685, 775. 1821. Mitt. In J. Proc. Linn. Soc. 5: 123. 1861. *Jungermannia lyellii* Hook., Brit. Jungerm. Pl. 77. 1816. *Pallavicinia canarus* Steph., Sp. Hepat. 6: 62. 1924.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, from the bank of the river Boleswar at Malidar, *ca* 70 m, 15.04.2012, *S. Das* 25032 (Assam University Herbarium).

Distribution: India [Eastern Himalaya (Assam), Central India (Madhya Pradesh), Western Ghats (Karnataka, Tamil Nadu)], Sri Lanka, Java, Singapore, Philippines, Japan, Europe, New Zealand, Africa, America (Bapna & Kachroo, 2000; Singh & Barbhuiya, 2012).

Aneuraceae H. Klinggr.

Aneura maxima* (Schiffn.) Steph., Sp. hepat. 1: 270. 1899. *Riccardia maxima* Schiffn. In Kaiserl. Akad. Wiss. Wien. Math-Naturwiss Kl. Denkschr. 67: 178. 1898. *Aneura pellioides* (Horik.) Inoue in J. Hattori Bot. Lab. 25: 209. 1962.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, from the bank of the river Boleswar at Malidar, *ca* 70 m, 15.04.2012, *S. Das* 25033; Marwacherra, *ca* 50 m, 06.05.2012, *S. Das* 25063 ((Assam University Herbarium).

Distribution: India [Eastern Himalaya (Arunachal Pradesh, Assam - present study, Manipur, Sikkim, West Bengal), Western Ghats (Tamil Nadu)], China, Japan, Australia (Srivastava & Udar, 1976; Das, 2009; Singh *et al*., 2010).

Note: The present ongoing study records *A. maxima* for the first time from the state of Assam. Earlier, in India, it was known from Arunachal Pradesh, Manipur, Sikkim and West Bengal of Eastern Himalaya and Tamil Nadu of Western Ghats.The species is common in the sanctuary.

Riccardia multifida (L.) Gray in Nat. Arr. Brit. Pl. 1: 684. 1821; S.C. Srivast. & Udar in Biol. Mem. 1: 121. 1976. *Jungermannia multifida* L., Sp. Pl. 1:1136. 1753.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, from the bank of the river Boleswar at Malidar, *ca* 70 m, 15.04.2012, *S. Das* 25033b (Assam University Herbarium).

Distribution: India: [Eastern Himalaya (Arunachal Pradesh, Assam, West Bengal), Western Ghats (Tamil Nadu)], Bhutan (Srivastava & Udar, 1976; Das, 2009; Singh & Barbhuiya, 2012).

* ***Riccardia tenuicostata*** Schiffn. In Kaiserl. Akad. Wiss. Wien, Math.-Naturwiss Kl., Denkschr.67: 166.1898; S.C. Srivast. & Udar in Biol. Mem.1: 128. 1976.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, along Shilong-Malidar road at Malidar, *ca* 80 m, 15.04.2012, *S. Das* 25047 (Assam University Herbarium).

Distribution: India [Eastern Himalaya (Arunachal Pradesh, Assam - present study, Manipur, Meghalaya, Sikkim, West Bengal), Western Himalaya (Himachal Pradesh, Uttarakhand), Western Ghats (Tamil Nadu)], Singapore, Indonesia, Malaysia (Srivastava & Udar, 1976; Singh & Nath, 2007; Singh & Singh, 2010; Singh *et al*., 2010).

Note: The present ongoing study records *R. tenuicostata* for the first time from the state of Assam. Earlier, in India, it was known from Arunachal Pradesh, Manipur, Meghalaya, Sikkim and West Bengal of Eastern Himalaya, Himachal Pradesh and Uttarakhand of Western Himalaya and Tamil Nadu of Western Ghats. The species is rare in the sanctuary.

Marchantiales Limpr.
Cyathodiaceae Stotler & Crand.-Stotl.

Cyathodium aureonitens (Griff.) Mitt., J. Linn. Soc., Bot. 22: 298, 1887. S.C. Srivast. & R. Dixit in J. Hattori Bot. Lab. 80 : 177. 1996. *Synhymenium aureonitens* Griff., Not. Pl. Asiat. 2: 344.1849.

Specimen examined: Assam, Cachar district, Barail Wildlife Sanctuary, Malidar, *ca* 80 m, 15.04.2012, *S. Das* 25030a (Assam University Herbarium).

Distribution: India [Eastern Himalaya (Assam, Sikkim), Western Himalaya (Himachal Pradesh, Uttarakhand), Western Ghats (Tamil Nadu)], Thailand, Equatorial Guinea (Srivastava & Dixit,1996; Müller, 2006, Asthana *et al*., 2008; Lai *et al*., 2008; Singh *et al*., 2008a; Daniels, 2010; Singh & Singh, 2010).

Conocephalaceae Müll. Frib. *ex* Grolle

* ***Conocephalum conicum*** (L.) Dumort., Comment. bot. 115. 1822; Kashyap, Liverw. W. Himal. 1: 44. 1929. *Marchantia conica* L., Sp. pl. 2: 1138. 1753.

Specimen examined: Assam, Cachar district, Barail Wildlife Sanctuary, Marwacherra, *ca* 50 m, 06.05.2012, *S. Das* 25052a (Assam University Herbarium).

Distribution: India [Eastern Himalaya (Arunachal Pradesh, Assam - present study, Manipur, Sikkim, West Bengal), Western Himalaya (Himachal Pradesh, Jammu & Kashmir, Uttarakhand), Western Ghats (Kerala)], Pakisthan, Nepal, Bhutan, China, Japan, Korea,CIS, Europe, North Africa, North America (Kashyap, 1929; Singh, 1996; Nair *et al*., 2008; Singh & Singh, 2009; Singh *et al*., 2010).

Note: The present ongoing study records *C. conicum* for the first time from the state of Assam. Earlier, in India, it was known from Arunachal Pradesh, Manipur, Sikkim and West Bengal of Eastern Himalaya, Himachal Pradesh, Jammu & Kashmir and Uttarakhand of Western Himalaya and Kerala of Western Ghats.

* ***Conocephalum japonicum*** (Thunb.) Grolle. in J. Hattori Bot. Lab. 68: 423. 1990; D. K. Singh & Sushil K. Singh in Indian J. Forest. 26: 442. 2003. *Marchantia japonica* Thunb., Fl. Jap. 344. 1784.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, from the bank of the river Boleswar at Malidar, *ca* 70 m, 15.04.2012, *S. Das* 25033c (Assam University Herbarium).

Distribution: India: [Eastern Himalaya (Arunahal Pradesh, Assam - present study, Sikkim, West Bengal)], Nepal, Bhutan, Taiwan, Korea, Japan, China (Singh, 1996; Singh & Singh, 2003, Das, 2009).

Note: The present ongoing study records *C. japonicum* for the first time from the state of Assam. Earlier, in India, it was known from Arunachal Pradesh, Sikkim and West Bengal only. The species is rare in the sanctuary.

Marchantiaceae (Bisch.) Lindl.

Dumortiera hirsuta (Sw.) Nees in Reinw.*et al*. Nova Acta Phys. Med. Acad. Caes.Leop. Carol. Nat. Cur. 12: 410.1824; Kashyap, Liverw. W. Himal. 1: 42. 1929. *Marchantia hirsuta* Sw., Prodr. 145. 1788.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, from the bank of the river Boleswar at Malidar, *ca* 70 m, 15.04.2012, *S. Das* 25033a, 25034 (Assam University Herbarium).

Distribution: India [Eastern Himalaya (Arunachal Pradesh, Assam, Manipur, Meghalaya, Sikkim, West Bengal), Western Himalaya (Himachal Pradesh, Uttarakhand), Western Ghats (Tamil Nadu), Central India (Madhya Pradesh)], Nepal, Bhutan, Sri Lanka, China, Korea, Japan, Indonesia, Thailand, Philippines, New Zealand, Australia, Africa, Europe, North & South America (Bapna & Kachroo, 2000; Das, 2009; Singh & Singh, 2009; Singh *et al*., 2010; Singh & Barbhuiya, 2012).

Marchantia linearis Lehm. & Lindenb. In Lehm., Nov. stirp. pug. 4: 8.1832; Kachroo & D.B. Deb in J. Univ. Gauhati 5: 119. 1954; V.B. Singh in Bull. Lucknow Natl. Bot. Gard.125: 13. 1966.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, Damcherra, *ca* 200 m, 11.03.2012, *S. Das* 25028; from the bank of the river Boleswar at Malidar, *ca* 70 m, 15.04.2012, *S. Das* 25035 (Assam University Herbarium).

Distribution: India [Eastern Himalaya (Assam, Manipur, Meghalaya, Sikkim, West Bengal), Central India (Madhya Pradesh), Punjab & West Rajasthan (Punjab), Western Ghats (Kerala)], Pakistan, Nepal, Indonesia (Mitten, 1861; Chopra, 1943; Kachroo & Deb, 1954; Asthana & Nath, 2007; Singh *et al.*, 2010).

Marchantia subintegra Mitt. in J. Proc. Linn. Soc. Bot. 5: 125. 1861; Bisch. In Bryophyt. Biblioth. 38: 235. 1989.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, from the bank of the river Boleswar at Malidar, *ca* 70 m, 15.04.2012, *S. Das* 25040 (Assam University Herbarium).

Distribution: India [Eastern Himalaya (Arunachal Pradesh, Assam, Manipur, Sikkim, West Bengal)], Nepal, Bhutan (Bischler, 1989; Das, 2009; Singh *et al*., 2010; Singh & Barbhuiya, 2012).

Ricciaceae Rchb.

Riccia frostii Austin in Bull.Torrey Bot. Club. 6: 17. 1875; K.P. Srivast. in Bull.Lucknow Natl. Bot. Gard.104: 51. 1964. *Riccia sanguinea* Kashyap in J. Bombay Nat. Hist. Soc. 24: 349. 1916.

Specimens examined: Assam, Cachar district, Barail Wildlife Sanctuary, Marwacherra, *ca* 50 m, 06.05.2012, *S. Das* 25069 ((Assam University Herbarium).

Distribution: India [Eastern Himalaya (Assam, Manipur, Sikkim), Western Himalaya (Jammu & Kashmir, Uttarakhand), Gangetic plains (Uttar Pradesh, West Bengal), Punjab & West Rajasthan (Rajasthan), Western Ghats (Kerala, Tamil Nadu)], Bangladesh, Pakistan, China, Vietnam, Africa, Europe, North & South America (Srivastava, 1964; Singh *et al*., 2008a; Fattah & Sarker, 2010; Singh *et al*., 2010; Singh *et al*., 2010a; Singh & Barbhuiya, 2012).

(* Taxa New to Assam; # Taxa Endemic to India)

7. Microhabitats of taxa

The total taxa identified yet show a wide range of distribution considering their microhabitats. The species are found growing on loose sandy soil to bare moist rock, root to bark of higher plants and rarely, on leaves of higher plants and decaying matters.

Out of 24 genera identified, 46% have been found growing purely as terrestrials, 25% as purely epiphytes and 29% have been found to grow both as terrestrials as well as epiphytes. Table II reflects the microhabitat diversity of each taxon within Barail Wildlife Sanctuary.

Sl. No.	**Name of taxa**	**Habitats**					
		Terrestrial		***Epiphytic***		***Lignico-lous***	***Aquatic***
		Terrico-lous	***Saxico-lous***	***Cortico-lous***	***Foliico-lous***		
1.	*Bazzania sumbavensis*	on moist soil near river bank.	on loose soil over rock in moist & shady places; in crevices of rocks under shady condition				
2.	*B. tridens*	on loose sandy soil in shady places					
3.	*Cephalozia pandei*		on thin film of loose sandy soil over rock in moist & shady places				

4.	*Solenostoma purpuratum*	growing on loose sandy soil in shady places along the roadside.					
5.	*S. tetragonum*		on thin film of loose sandy soil over rock in moist & shady places				
6.	*Chiloscyphus campanulatus*	on moist soil in shady places	on thin film of soil over rock wall exposed to sunlight, along the road side.				
7.	*Heteroscy-phus argutus*	growing on loose sandy soil in shady places along the roadside.	on loose soil over rock; in rock crevices under shady condition	on *Arum* root			
8.	*H. hyalinus*	on loose moist soil at river bank, under shady condition	in crevices of rock under shady condition ; on loose soil over rock	on *Arum* root			
9.	*H. orbiculatus*		on loose soil over rock				
10.	*H. palniensis*						Periodi-cally drying,

							on bare moist rock beneath river bed; occasionally sub-merged during monsoon
11.	*H. pandei*	growing on damp soil in shady places in associa-tion with mosses					
12.	*Plagiochila grollei*		in crevices of rocks under shady condition				
13.	*P. parvifolia*		on wet soft soil accumulated in between crevices of rocks, under extremely shady condition				
14.	*P. perserrata*		on wet soft soil accumulated in between crevices of rocks, under extremely shady condition				
15.	*P. retusa*		on bare rock surface under				

			exposed condition				
16.	*Radula assamica*		on loose soil over rock in moist and shady places.				
17.	*R. obscura*		on loose moist soil in rock crevices under shady condition				
18.	*Frullania ericoides*			appressed to bark of higher plants			
19.	*F. muscicola*		on loose moist soil in rock crevices under shady condition	on root of *Arum* sp.			
20.	*Archilejeunea minutilobula*			on bark of angio-sperms			
21.	*Cheilolejeune a subopaca*			on twig of angio-sperms			
22.	*Cololejeunea furcilobulata*			on twig of angio-sperms			
23.	*C. siangensis*			appressed to rough stem bark of angio-sperms			
24.	*C. trichomanis*			on bark of angio-sperms;		on decaying twig near culvert	
25.	*Lejeunea obscura*			on bark of *Alstonia scholaris* along			

				road side			
26.	*Leptolejeunea elliptica*				appressed on fern leaf		
27.	*Lopholejeu-nea nigricans*		on loose moist soil in rock crevices				
28.	*L. subfusca*		on bare rock wall & rock crevices with dripping water, in shady condition	on bark of *Alstonia scholaris* along road side			
29.	*Microlejeune a punctiformis*		on loose moist soil in rock crevices under shady condition	on bark of *Alstonia scholaris* along road side			
30.	*Trocholejeune a infuscata*			on bark of higher plants under moist condition			
31.	*Pallavicinia ambigua*	on moist soil in exposed places					Cons-tantly wet; on bare rock with conti-nuously dripping water along ditch
32.	*P. lyellii*			on loose soil adhered on *Arum* root			
33.	*Aneura maxima*		on bare rock wall				periodic ally

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			and rock crevices with drooping water, in shady condition				drying, on bare moist rock beneath river bed; occasionally sub-merged during monsoon
34.	*Riccardia multifida*						periodically drying, on bare moist rock beneath river bed; occasionally sub-merged during monsoon
35.	*R. tenuicostata*		on bare shady rock along roadside				
36.	*Cyathodium aureonitens*						periodically drying, on bare moist rock beneath river bed; occasionally sub-merged during monsoon
37.	*Conocephalum conicum*		on thin film of sandy				

			soil over rock, near a ditch along roadside				
38.	*C. japonicum*						periodically drying, on bare moist rock beneath river bed; occasionally submerged during monsoon
39.	*Dumortiera hirsuta*		on bare rock surface				periodically drying, on bare moist rock beneath river bed; occasionally submerged during monsoon
40.	*Marchantia linearis*	on moist soil					periodically drying, on bare moist rock along bank of river
41.	*M. subintegra*	on loose moist soil at river bank, under shady condition					

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42.	*Riccia frostii*	on moist soil under shady condition					

Table II: Microhabitat diversity of the species in Barail Wildlife Sanctuary

8. Conclusion

It is found from the above study that genera growing in vast range of microhabitats are highly successful in having wide range of distribution, and hence, these taxa have contributed a large percentage of the total liverwort flora of BWS. Genera like *Heteroscyphus*, *Frullania*, *Pallavicinia*, members of the family Lejeuneaceae, etc. are very successful in using wide range of substrates. This phenomenon has also reduced the chance of these species for being disjuncts, and at the same time has increased the evolution of endemic taxa within the sacntuary.

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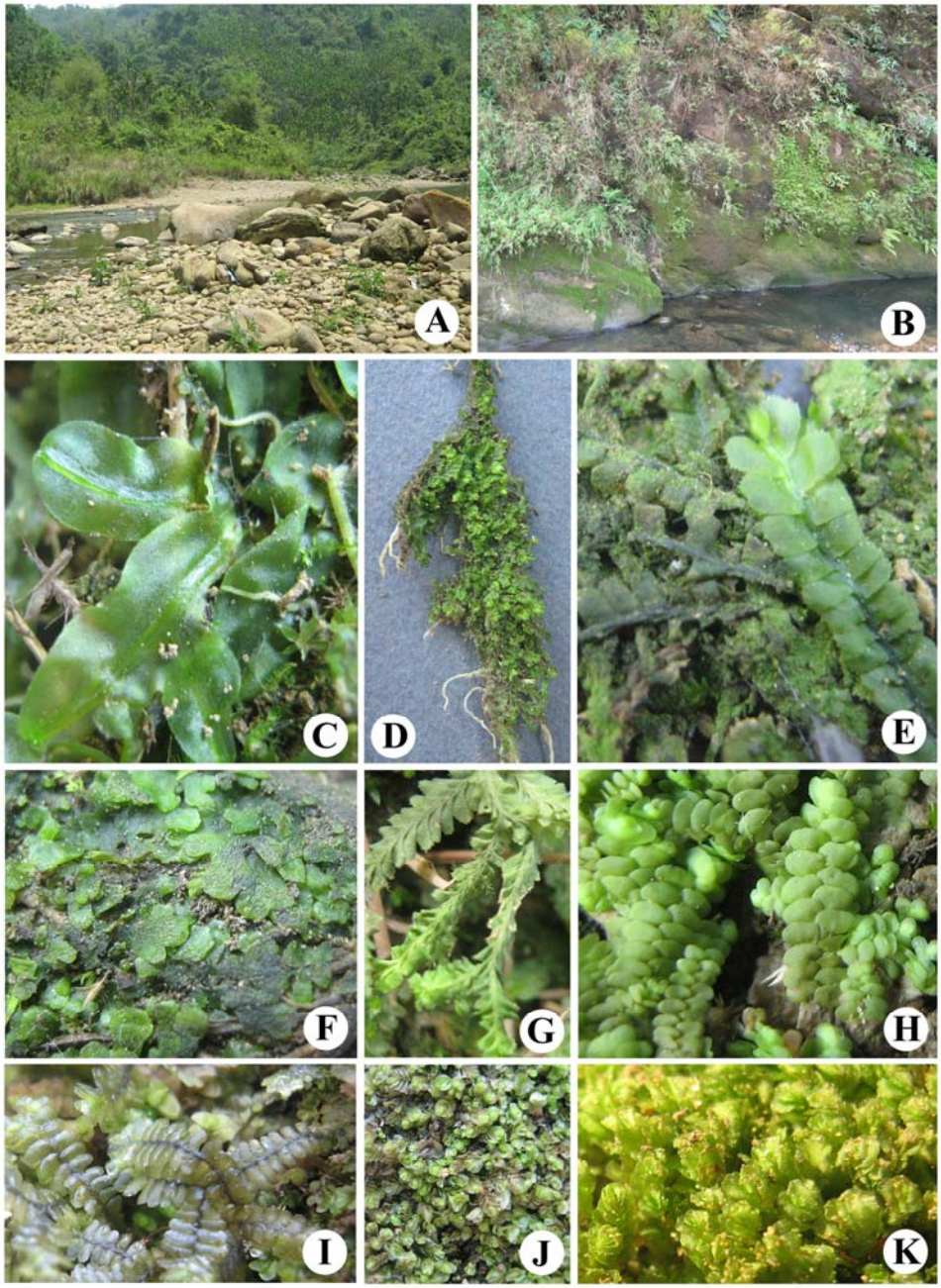

Fig. 2. Collection sites (A-B), field photographs of different taxa (C, E-K) and their microhabitat (D): A. Collection site at Malidar; B. Collection site at Marwacherra; C. *Pallavicinia lyellii* (Hook.) Carruth; D. Liverworts growing on root of angiosperm; E. *Heteroscyphus argutus* (Reinw. *et al*.) Schiffn.; F. *Riccardia tenuicostata* Schiffn.; G. *Plagiochila perserrata* Herzog; H. *Radula obscura* Mitt. I. *Bazzania sumbavensis* (Gottsche *ex* Steph.) Steph.; J. *Solenostoma tetragonum* (Lindenb.) R. M. Schust. *ex* Váňa *et* D. G. Long; K. *Solenostoma purpuratum* (Mitt.) Steph.