

## BRYOPHYTE FLORA OF HUNAN PROVINCE, CHINA. 16. COMPLEX THALLOIDS (MARCHANTIOPSIDA, HEPATICAE)

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**Abstract.** The occurrence of 13 species belonging to eight complex thalloid genera and six families are reported for Hunan. *Conocephalum japonicum* (Thunb.) Grolle, *C. salebrosum* Szweykowski *et al.* and *Dumortiera hirsuta* (Sw.) Nees are moderately common in Hunan, *Conocephalum conicum* (L.) Dumort., *Marchantia paleacea* Bertol. and *M. emarginata* Reinw. *et al.* subsp. *tosana* (Steph.) Bischler are rather rare, *M. polymorpha* L., *Plagiochasma pterospermum* Mass., *Reboulia hemisphaerica* (L.) Raddi, and *Wiesnerella denutata* (Mitt.) Steph. are rare and *Asterella khasyana* (Griff.) Pandé *et al.*, *Plagiochasma appendiculatum* Lehm. & Lindenb. and *Riccia fluitans* L. are very rare. Of them the following are new to Hunan: Genus *Plagiochasma* with two species, *P. appendiculatum*, *P. pterospermum*, *Riccia fluitans*, *Marchantia paleacea* and *Conocephalum salebrosum*. The altitudinal ranges of taxa in Hunan are mapped. The distribution, ecology and the classification of taxa into distributional elements, as well as the characters are discussed. Some thalloid hepatic genera, i.e. *Conocephalum* and *Dumortiera* include cryptic taxa that pose unsolved taxonomic problems that await further future research.

**Key words:** *Asterella*, China, complex thalloids, *Conocephalum*, cryptic species, distribution, *Dumortiera*, Hepaticae, Hunan, *Marchantia*, *Plagiochasma*, *Reboulia*, *Riccia*, *Wiesnerella*

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### INTRODUCTION

This paper belongs to the series dealing with the bryophyte flora of the Hunan Province, China. Essential background information about material and methods, and abbreviations of collecting localities of three first excursions and geographical areas used in this study are given in parts 1 and 3 (Koponen *et al.* 2000, 2004). The collecting localities from two later excursions, in 2000 and 2001 will be reported later. The paper no. 15 of the series was by Piippo (2010). The thalloid hepatics of Hunan Province were previously dealt with in Hunan in the papers by Rao *et al.* (1997), Koponen *et al.* (2000) and Piippo (2010).

The systematics of the Marchantiales has been dealt with recently by Bischler (1998), He-Nygrén *et al.* (2004, 2006), Long (2006a) and Crandall-Stotler *et al.* (2009). The determination of simple and complex thalloids is problematic since they seem to possess many cryptic species not yet sufficiently clarified taxonomically (see Szweykowski *et al.* 2005).

### *Dumortieraceae* Long 2006

The thallus is undifferentiated and only with vestigial air chambers. Ventral scales are rudimentary, in two rows, without appendages. Asexual reproduction is absent. Antheridia situated in terminal short-stalked disciform receptacles. Sporophytes on stalked receptacle. The family includes only one genus, *Dumortiera*.

### *Dumortiera* Nees 1824

The thallus is 8–30 mm wide, light or dark green, without purplish pigment, usually dichotomously branched. Upper thallus surface is smooth or occupied by papilliform chlorophyllose cells giving a velvety appearance. Frond margin is usually not crispate and the costa is usually visible also from dorsal side. Thallus is only weakly differentiated into layers, with vestigial air chambers and air pores absent or only few near the thallus apex, simple when present. There is no reticulation on

the dorsal surface. Rhizoids are pale, often radiating towards margins, sometimes modified as bristles.

The genus has been placed into the families Marchantiaceae or Wiesnerellaceae until Long (2006a) lifted it into its own family. Total lack of photosynthetic layers is exceptional for complex thalloids.

***Dumortiera hirsuta* (Sw.) Nees** Fig. 1

Nova Acta Acad. Leop.-Carol. German. Nat. Cur. **12**: 410. 1824. *Marchantia hirsuta* Sw., Prodr. Fl. Ind. Occid.: 145. 1788.

The great variability of *Dumortiera hirsuta* was pointed out by e.g. Piippo (1988), Akiyama *et al.* (2003, 2012) and Forrest *et al.* (2011). According to Forrest *et al.* (2011), there exist at least two genetically diverse species within *Dumortiera* and most probably several more. At least two genetically and geographically distinct clades are detectable. According to Akiyama *et al.* (2012), *D. hirsuta* has different ploidy levels that have been recognized at infraspecific rank under the species. These ploidy levels could warrant a specific status. In this paper *D. hirsuta* is treated as a largely polymorphic species. In Hunan the smoothness and roughness of the dorsal surface as well as the plant size varies, both characters possibly indicating different taxa.

DESCRIPTIONS: Piippo (1988), Paton (1999).

ILLUSTRATIONS: Piippo (1988: 100, 101, figs 3–5), Paton (1999: 565, fig. 285).

HABITATS AND SUBSTRATES IN HUNAN. *Dumortiera hirsuta* was collected most often in forested habitats in orotemperate deciduous and warm temperate evergreen primeval or secondary forests. The habitats include plantation forests of *Magnolia officinalis* subsp. *biloba* and *Tapiscia sinensis*, *Cunninghamia*, *Metasequoia*, *Cryptomeria* and bamboo (*Phyllostachys pubescens*). The cultivated areas were such as hotel garden and forest edge, along roadsides and trails e.g. in orchards, villages and fields. The habitats are brook sides or valleys or slopes, in wet, mesic or moist localities, usually in partial or full shadow at 273–1580 m (Fig. 1).

The substrates are: humus (often banks) (33), cliff (21), clay (16), sand (7), soil (4), humus on stone (3), rock top (3), stone (2), sand (2), litter (2), stone wall (1), humus on cliff (1), cliff crevice (1). Frequency in Hunan: moderately common (on 53 collecting localities of the total of 209).

RANGE IN HUNAN: BADAGONGSHAN. 39a. 55740. 39b. 48471. 40b. 55665. 42. 50485, 50486. 43. 48339. 44a. 48132, 54482. 44b. 48840, 48866. 45. 55499, 55555. 48. 48642, 48722. 50. 48739 in *Conocephalum salebrosum*, 48744. 52. 48288, 48304, 48306. 55a. 47895, 47905, 47939. 86b. Virtanen 61307. DAWESHAN. DAW 4. Enroth 63561. DAW 22. Virtanen 62249, 62263, 62293. HUPINGSHAN. 56b. 47880, 47884. 57. 48622. 58. 47672, 47673, 47674, 47737, 53700. 59. 49713, 49714, 49715, 53315, 53349, 53427. 60. 47823, 47833. 63. 47797, 47804. SHUNHUANGSHAN. S1. He 1397, 1452. S3. He 519. TAOUYUANDONG. 20a. 56782, 57225, 57255, 57969, 57983, 57994. 21a. 56029. 21c. 56083, 56100. 21d. 55967. 23b. 55858. 24. 56112, 56114, 56121, 56249. 31. 56334, 57930 in *Conocephalum salebrosum*. 34. 57027. WULINGYUAN. 15c. 16b. 16c. 17b. 17c. Rao 58433, 58471. 18a. 19a. 19b. 80. Rao 58364. YUANKOU. 74c. 61089, 61107. 74d. 60855, 60867. 76a. 61051. 76b. 60975, 61033. 77b. 60554, 60555. 78a. 60756, 60770, 60773. 78b. 60776. 78c. 60793, 60804. 78d. 60835, 60837. YUNSHAN. Y1. He 16, 17. Y6a. He 49, 51, 53, 76, 77. Y8. He 401, 403, 404. Y9. He 452, 453, 456, 457, 458.

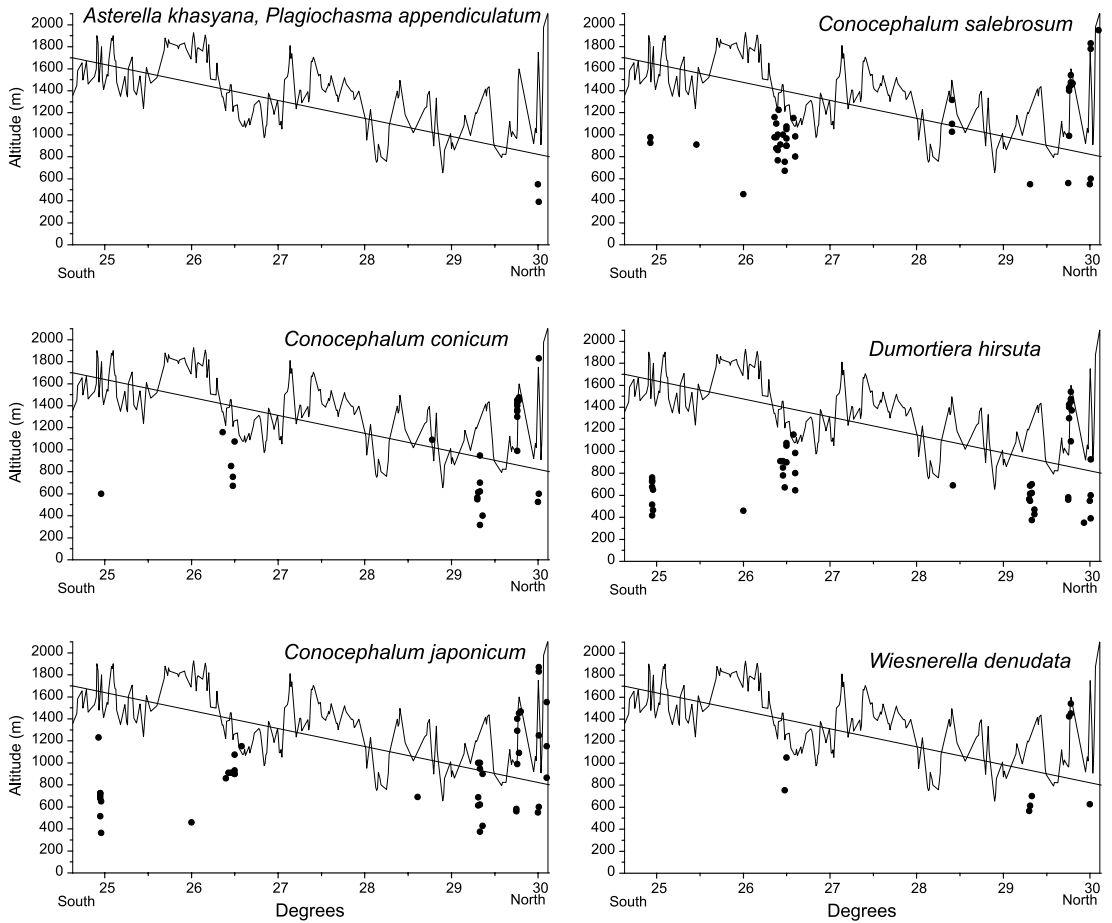
XINNING CO., along road side in Lang Shan National Forest Park, on clay. Warm temperate (subtropical zone), 30 Nov. 2001 He 1462.

RANGE IN CHINA (Piippo 1990; Fang *et al.* 1998): Anhui, Yunnan, Guizhou, Jiangxi, Guangdong, Fujian, Zhejiang and Taiwan.

TOTAL RANGE (Pócs 1976; Piippo 1988; Schuster 1992; Furuki & Higuchi 1995): Pantropical – temperate, oceanic, extending to Western Europe.

**Wiesnerellaceae** Inoue 1976

The thallus is differentiated, with simple air pores. Ventral scales are in 2 rows, very delicate, broadly



**Fig. 1.** The altitudinal distribution of *Asterella khasyana* (Griff.) Pandé *et al.*, *Conocephalum conicum* (L.) Dumort., *C. japonicum* (Thunb.) Grolle, *C. salebrosum* Szweykowski, Buczkowska & Odrzykoski, *Dumortiera hirsuta* (Sw.) Nees, *Plagiochasma appendiculatum* Lehm. & Lindenb. and *Wiesnerella denudata* (Mitt.) Steph. in Hunan. Oblique line – border of warm temperate and orotemperate zone.

lunate, with one reniform, apically rounded appendage, either hyaline or somewhat purplish. Antheridia situate in terminal cushions; sporophytes on stalked receptacles with compound air pores and the stalk has two rhizoid furrows. Asexual reproduction is absent.

The family has only one genus, *Wiesnerella*.

*Wiesnerella* Schiffn. 1898

*Wiesnerella denudata* (Mitt.) Steph. Fig. 1

Spec. Hep. 1: 154. 1899. *Dumortiera denudata* Mitt., J. Proc. Linn. Soc. 5: 125. 1860.

DESCRIPTION: Piippo (1988).

ILLUSTRATIONS: Inoue (1976: 151, pl. 75), Piippo (1988: 10, figs 5e–g, 6), Lin (2000: 363), Huang *et al.* (2012: 318–320, figs 1, 2).

The thallus of *Wiesnerella denudata* is 8–13 mm wide, green to dark green, without purplish pigment, median parts are usually darker than distal parts, usually irregularly dichotomously branched, margins are repand-undulate, obcordate at apex, costa is moderately well-defined below. Cells of the dorsal epidermis are almost isodiametric, rather thin-walled, without trigones; air pores are dis-

tinctly visible, the dorsal surface is not reticulate. Rhizoids are almost colourless.

**HABITATS AND SUBSTRATES IN HUNAN.** Most of the collections came from primeval evergreen broad-leaved forest of the warm temperate zone, more rarely from deciduous mixed forest (*Tilia*, *Betula*, *Fagus*, *Acer*, etc.) in the orotemperate zone in Badagongshan. Man-made habitats were bamboo forest (*Phyllostachys pubescens*), field edges with bushes and semi-open, grazed secondary evergreen broad-leaved forest at 550–1580 m (Fig. 1). It usually occurs in localities partial shade to full shade, moist or mesic or even wet localities. Substrates: humus on rock or cliff (4), on (sand) on cliff usually at brook side (4), sand (3), dry boulder (3), stone (3), cliff underhang at brook side (2), on humus (1), clay (1). Frequency in Hunan: rare (12/209).

**RANGE IN HUNAN: BADAGONGSHAN.** 44b. 48845. 45. 55474, 55476. 48. 48713. 55a. 47934. **HUPINGSHAN.** 59. 49747, 53301, 53459. **SHUNHUANGSHAN.** 56. He 783. **TAOYUANDONG.** 20a. 57231, 57256, 57268. 21a. 56025, 56035. 31. 57875, 57926. 32. 57162. **YUNSHAN.** 51. He 18. 56a. He 62, 66, 71.

**RANGE IN CHINA** (Piippo 1990; Zhu *et al.* 1998): Xizang, Sichuan, Zhejiang, Yunnan, Hunan and Taiwan.

**TOTAL RANGE** (Piippo 1988; Furuki & Higuchi 1995; Koponen *et al.* 2000): Afr 3 (Mascarenes); As 2: Chi Ja Ko Tai; As 3: Afganistan, Himalaya NW, In; As 4: Ind (Java, Sumatra) Ma PNG; Oc: Haw.

### **Conocephalaceae** K. Müll. *ex* Grolle 1972

The thallus is differentiated, with simple air pores. Ventral scales are in 2 rows, with one reniform appendage. Antheridia situated in terminal cushions. Sporophytes are on stalked receptacles, with compound air pores and the stalk with one rhizoid furrow; asexual reproduction by fragmenting thallus tips or ventral bulbils.

The family is monotypic.

### **Conocephalum** Hill 1773

The genus *Conocephalum* poses many taxonomic problems since its species contain many cryptic taxa. *C. salebrosum* was recently given a specific status by Szweykowski *et al.* (2005) which led to other regional papers (Natcheva 2008; Borovichev *et al.* 2009). However, the species is easier to distinguish in Europe than in Asia (David Long, pers. comm.).

### **Conocephalum conicum** (L.) Dumort. Fig. 1

Ex Cogn., Bull. Soc. Roy. Bot. Belgique **10**: 278, 296. '1871' 1872. *Marchantia conica* L., Spec. Plant. Ed. 1: 1138. 1753. *Fegatella conica* Corda in Opiz (ed.), Beiträge zur Naturgesch. **1**: 649. 1828.

**DESCRIPTIONS:** Lin (2000), Damsholt (2002), Szweykowski *et al.* (2005).

**ILLUSTRATIONS:** Schiffner (1893: 34, fig. 19A–C), Lin (2000: 146), Damsholt (2002: 729, pl. 274), Szweykowski *et al.* (2005: figs 4a, c, e, g, 5a, c, e, 6, 7), Natcheva (2008: figs 1b, 2b, 3b), Borovichev *et al.* (2009: fig. 1: 7–12).

*Conocephalum conicum* is characterized by large size, shiny dorsal thallus, wide hyaline margin of the thallus composed usually of 3–4, sometimes ± elongated cells, smooth dorsal surface and limits between air chambers usually shallow or indistinct. The highest cell of an air chamber wall is not inserted, only touching the dorsal epidermal cells and therefore the thallus has a flat surface (see Szweykowski *et al.* 2005; Borovichev *et al.* 2009). The junctions of the air chambers are on the same level with the thallus surface. The margin of the thallus is plane or nearly so. The number of air chamber rows between costa and thallus is usually 6–8. The reticulation of the dorsal surface is not very clear. The best characters for the plants in Hunan are the flat dorsal surface, plane thallus margin, shallow and obscure reticulation of the thallus surface, and usually wide hyaline margin.

We have treated the specimens listed below as *C. conicum*, even though in the future while the molecular research on this problematic genus continues, they might bear another name. Miwa *et al.* (2009) found six cryptic species in *C. conicum* (see

also Ki *et al.* 2001). According to David Long (pers. comm.), Asian species with the name *C. conicum* are not the same species as in Europe.

HABITATS AND SUBSTRATES IN HUNAN. *Conocephalum conicum* grows in primeval and secondary evergreen forests of the warm temperate zone, in deciduous – evergreen mixed forest and in second growth deciduous forests of the orotemperate zone and in *Liriodendron*, *Alniphyllum*, *Metasequoia* and *Phellodendron* plantations, in open, dry, usually mesic to wet, partial to full shaded localities, often on river and brook sides or trail banks, at 550–1860 m (Fig. 1). Substrates: cliff (4), humus on cliff (4), humus (3), rock (2), rock top (1), boulder (1), stone (1), clay (1), trunk (1), litter (1), sand (1). Frequency in Hunan: rather rare (23/209).

RANGE IN HUNAN: BADAGONGSHAN. 40b. 55667. 41. 48440. 43. 48342. 44a. 48146, 48179. 44b. 48891. 47. 48218. 48. 48705. 50. 50130. 86b. 58647. 87. 58862. 88a. 59077. DAWEISHAN. DAW 16. 61791. HUPINGSHAN. 59. 53339. 60. 47823a. 70. 47612. SHUNHUANGSHAN. S17. He 1361. TAOUYUANDONG. 20a. 57986. 21a. 56019. 21d. 55966. 34. 57005. WULINGYUAN. 17b. 18a. 19b.

RANGE IN CHINA (Piippo 1990): in many provinces. Many previous records must belong to *C. salebrosum*.

TOTAL RANGE: Subboreal–montane (Damsholt 2002); Koponen *et al.* (2000): Am 1; Eur; Afr 1; As 1; As 2: Chi Ja Ko Tai; As 3: In Bhu Darjeeling, NW In, Kashmir, Ne Pak Si. Map: Szwejkowski *et al.* (2005): 8.1.

### *Conocephalum japonicum* (Thunb.) Grolle

Fig. 1

J. Hattori Bot. Lab. 55: 501. 1984. *C. supradecompositum* (Lindb.) Steph., Spec. Hep. 1: 141. 1899.

DESCRIPTIONS: Kitagawa (1982), Lin (2000).

ILLUSTRATIONS: Inoue (1976: 149, pl. 74, as *C. supradecompositum*), Gao & Zhang (1981: 189, fig. 82: 8–12); Lin (2000: 147).

*Conocephalum japonicum* is an annual weedy species, small, rather densely branched, with the

thallus only 4–6 mm wide. The apices are frequently branched, the tips produce subrotund gemmae. The reticulation of the dorsal surface is distinct and air pores clearly visible. The thallus margins are often purplish. The species is usually easy to distinguish from the other two *Conocephalum* taxa in China due to its narrow thalli with numerous branches and apical gemmae that are usually present. However, some small forms of *C. salebrosum* may pose some difficulties in separation. Miwa *et al.* (2003) found out that *C. japonicum* also includes cryptic species that might be reproductively isolated.

HABITATS AND SUBSTRATES IN HUNAN. *Conocephalum japonicum* grows both in warm temperate and orotemperate zones in evergreen broad-leaved forests and deciduous forests and commonly in plantation forests of *Cunninghamia*, bamboo and *Metasequoia* and was collected from *Amorfofallus* and *Ipomaea batatas* field; most often along road and trail sides in orchards and fields, or brook sides, in mesic to moist habitats in open to full shade at 400–1880 m (Fig. 1). Substrates: on humus (19), sand (12), clay (9), stone (6), cliff (6), field (4), sand on cliff (2), humus in cliff crevice (1), soil (1), gravel (1), under cliff (1), waterfall outcrop (1), boulder (1), rock top (1), twig (1). Frequency in Hunan: moderately common (44/209).

RANGE IN HUNAN: BADAGONGSHAN. 39a. 55741, 55758, 55781. 39b. 48492. 40a. 55597. 43. 48418. 46. 48238, 48240, 48244. 47. 48226. 49. 48795. 86b. 58679. DAWEISHAN. DAW 4. Enroth 63541, Virtanen 62418. DAW 22. Virtanen 62303. HUPINGSHAN. 58. 47721. 60. 47839. 61. 49935, 49977, 52233. 65. 53491. 66. 47788, 54126, 54138. 67. 53515. 70. 47631. 71. 47591, 47595, 47604. Mangshan. 10a. SHUNHUANGSHAN. S1. He 1383, 1384, 1408, 1412, 1420, 1457. S3. He 475, 469, 493, 495, 503. S6. 790. TAOUYUANDONG. 22. 56226. 23b. 55795, 55836, 55861. 24. 56250, 56287, 56925, 56981, 56982. 25. 56643. 34. 57080. WULINGYUAN. 15c. 16b. 16c. 16d. 18a. Rao 58585. 19a. 19d. 19e. 80. 58354. 81b. 58393. YUANKOU. 74c. 61082. 76a. 61054. 76b. 60969, 60970, 60972, 60974. 77b. 60557. 78a. 60775.

78b. 60777, 60783 in *Marchantia paleacea*, 60785, 60787. YUNSHAN. *YI*. He 1, 32.

RANGE IN CHINA (Piippo 1990; Zhang & Lin 1997; Koponen *et al.* 2000): Xizang, Shaanxi, Liaoning, Jiangsu, Yunnan, Hunan, Fujian, Hong Kong, Zhejiang, Taiwan.

TOTAL RANGE (cf. Long & Grolle 1990; Furuki & Higuchi 1995; Koponen *et al.* 2000; Dandotiya *et al.* 2011): As 1: E Siberia, Kamchatka; As 2: Chi Ja Ko Tai; As 3: Assam Bhu Darjeeling Ne In.

*Conocephalum salebrosum* Szweykowski, Buczkowska & Odrzykoski Fig. 1  
Pl. Syst. Evol. **253**: 146. 2005.

DESCRIPTION: Szweykowski *et al.* (2005).

ILLUSTRATIONS: Szweykowski *et al.* (2005: figs. 3b, 4b, d, f, h, 5b, d, f, 7.2), Natcheva (2008: 324, figs. 1a, 2a, 3a), Borovichev *et al.* (2009: 117, fig. 1: 1–6).

Long (2006b) confirmed the occurrence of *C. salebrosum* for the Sino-Himalayan region. According to him (pers. comm.), *C. salebrosum* is common in Asia. According to him: ‘*C. conicum* is shiny, *C. salebrosum* is dull. *C. conicum* does not have grooved reticulations, the reticulations are faint and much less visible to the naked eye than the pores. In *C. salebrosum* the reticulations are distinctly grooved, especially towards the thallus apex, and to the naked eye the grooves are more conspicuous than the pores. These work well in most cases, but extreme shade forms in caves can be almost impossible. I think *C. salebrosum* favours more calcareous sites’.

According to Szweykowski *et al.* (2005), Natcheva (2008) and Borovichev *et al.* (2009), typical for *C. salebrosum* are dullness of dorsal thallus surface, and a hyaline margin usually with 1 or 2 ± elongated cells. The dorsal thallus surface is uneven with limits between air chambers distinct, and the highest cells of air chamber walls are inserted between epidermal cells. Outer epidermal cell walls are inflated giving the epidermis a verrucose appearance. The number of air chamber rows between costa and thallus is usually 4–5. In Hunan the species is best recognizable by middle-

sized plants, usually not as large as *C. conicum*, distinct dorsal surface reticulation especially near the thallus apex, borders between air chambers conspicuous, verrucose epidermis, thallus margin undulate or recurved, and the margin with 1–2 cells wide hyaline margin. In Hunan *C. salebrosum* is more common than *C. conicum* and it has a wider ecological amplitude.

HABITATS AND SUBSTRATES IN HUNAN. *Conocephalum salebrosum* occurs in primeval and second growth evergreen broad-leaved forests of Elaeocarpaceae–Fagaceae–Lauraceae–Magnoliaceae–Stachyuraceae in warm temperate zone and in various deciduous forests (*Acer*, *Betula*, *Fagus*, *Tilia* etc.) and bush landscape in orotemperate zone, in *Liriodendron*, *Alniphyllum*, *Metasequoia* and *Phellodendron* plantations, in mature bamboo groves and semi-open grazed secondary broad-leaved forests, in villages and fields on road and brook sides usually partially or fully shaded, in moist or mesic sites at 273–2099 m (Fig. 1). Substrates: cliff (22), stone (19), humus (15), boulder (8), clay (6), humus on cliff (3), cliff crevice (2), sand (2), soil (2), under cliff (1), rock top (1), seepage (1), tree root (2), trunk (1), litter (1), gravel (1). Frequency in Hunan: moderately common (53/209).

RANGE IN HUNAN: BADAGONGSHAN. 39b. 48474. 43. 48347, 48419. 44a. 48094, 48133, 48139. 44b. 48865. 45. 55542, 55559. 46. 48252. 47. 48225. 48. 48667, 48678. 50. 48739. 52. 48286, 48295. 55a. 47889, 47890, 47897, 47902, 47917, 47960, 54336. 92. Virtanen 61168, 61192, 61220. DAWESHAN. *DAW 15*. Enroth 63503, 63510. *DAW 16*. Enroth 63271. *DAW 20*. Enroth 63216. HUPINGSHAN. 58. 47559. 60. 47821, 47838. 68. 47783. 70. 47619. 72. 49869. SHUNHUANGSHAN. *S1*. He 1417. *S3*. He 532. *S5*. He 676, 677. *S6*. He 784. *S10*. He 956, 957. *S11*. He 992. *S12a*. He 1032, 1033, 1077, 1083. *S12b*. He 1106, 1112, 1114. *S13*. He 1141, 1148, 1155. *S16*. He 1293. *S17*. He 1321. TAOYUANDONG. 20a. 57984. 21a. 56020. 22. 56213. 23b. 55859. 24. 56248, 56279, 56292, 56294. 25c. 55399. 29. 56467. 31. 56342, 57856, 57908, 57928, 57929, 57930. 34. 57027. WULINGYUAN. 17c. 58451. YUANKOU. 79a. 60563. 79b. 60653, 60660, 60664,

60684, 60685, 60687. YUNSHAN. *YL*. He 3, 19, 23. *Y6a*. He 73. *Y8*. He 405, 417.

RANGE IN CHINA (cf. Long 2011): Sichuan, Hunan. New for Hunan.

TOTAL RANGE (Szweykowski *et al.* 2005): Eur, East Asia, North America. Map: Szweykowski *et al.* (2005: 8.2).

### Aytoniaceae Cavers 1911

The thallus is differentiated, with simple air pores; ventral scales are in two rows, with 1–4 appendages; antheridia are in terminal cushions on the thallus; sporophytes are on stalked receptacles, with compound air pores and the stalk with one rhizoid furrow. Asexual reproduction occurs by fragmenting thallus tips or ventral bulbils.

#### *Plagiochasma* Lehm. & Lindenb. 1832

*Plagiochasma* is a very drought-tolerant genus, similar or somewhat smaller in size to *Reboulia*, leathery, firm, variously branched, often with terminal innovations. The dorsal surface is smooth and not visibly areolate, lateral margins are usually purplish. Ventral scales are usually purplish with 1–2(–4) appendages. For the characters of the genus, see Bischler (1977). Genus *Plagiochasma* has six species in China (Piippo 1990; Zhu 2006). The genus is reported as new for Hunan.

#### *Plagiochasma appendiculatum* Lehm.

& Lindenb. *in* Lehmann

Fig. 1

Nov. Minus Cogn. *Stirp.* Pug. 4: 14. 1833. *P. rebouliaoides* Horik., *Bot. Mag. Tokyo* 49: 672. 1935.

DESCRIPTIONS: Kachroo (1954), Bischler (1979).

ILLUSTRATIONS: Horikawa (1934: 673, fig. 27, as *P. rebouliaoides*), Kachroo (1954: 46, fig. VII), Bischler (1978: 231, 232, 235, pls. I–III), Bischler (1979: 30, fig. I; 37, fig. III: 1–4).

*Plagiochasma appendiculatum* is easy to distinguish on the basis of its large size, adventitious shoots, apical tubers, smooth dorsal surface, and broadly lunate ventral scales with 1–2 appendages, which are large, round, occasionally acute, usually hyaline, but sometimes purplish. Soni

*et al.* (2009) noted genetic diversity in Indian populations.

RANGE IN HUNAN. *Plagiochasma appendiculatum* was collected only in two warm temperate collecting localities in Hunan: HUPINGSHAN. 57. 48633, secondary forest (*Ligustrum*, *Lonicera*, *Machilus*, *Pteroceltis*, on wet top of cliff on brook side at 390 m. 58. 47718, 47719, river valley in Elaeocarpaceae – Fagaceae – Lauraceae – Magnoliaceae – Stachyuraceae evergreen broad-leaved forest on partial shade, moist humus on boulder at 550 m (Fig. 1). Frequency in Hunan: very rare (2/209).

RANGE IN CHINA (cf. Piippo 1990; Soni *et al.* 2009): Hunan, Yunnan, Taiwan. New for Hunan.

TOTAL RANGE (Bischler 1979): Afr: Ethiopia, Kenya, Zimbabwe, Socotra, Tanzania, Eritrea; As 2: Chi Tai; As 3: Afganistan Birma In Kashmir Pak Himalaya Sikkim Vi Ne; As 4: Cel Phi; As 5: Yemen. Map: Bischler 1978: 236 (Carte 1), 1979: 32 (Carte 1).

#### *Plagiochasma pterospermum* Mass. (Fig. 2)

Mem. Accad. Agric. Verona 73: 46. 1897. *P. sessilicephalum* Horik., *J. Sci. Hiroshima Univ.*, ser. B, div. 2, Bot. 2: 109. 1934.

DESCRIPTION: Bischler (1979).

ILLUSTRATIONS: Bischler (1979: 57, fig. XI; 59, fig. XII; 63, fig. XIII).

The thallus of *Plagiochasma pterospermum* is 3–4 mm wide and rarely branched. The appendages of ventral scales strongly vary, and they often are red, triangular, long acuminate. The cells of the dorsal epidermis have large, usually nodulose trigones, and epidermal pores have distinct radial walls. *P. pterospermum* is not a very well defined species and is difficult to separate from *P. cordatum* Lehm. & Lindenb. when sterile. *P. cordatum* has a wider thallus that is almost always branched, epidermal cells have less distinct trigones, and epidermal pores have less distinct radial walls (Bischler 1979).

HABITATS AND SUBSTRATES IN HUNAN. In evergreen – deciduous broad-leaved forest, along river

in valley surrounded by secondary warm temperate forest and along river valley surrounded by arable land at 350–1130 m (Fig. 2). Substrates: on sand on slope (2), in full shade on moist cliff (1), cliff crevice near river (1), and on mesic humus in cliff crevice (1). Frequency in Hunan: rare (4/209).

RANGE IN HUNAN: HUPINGSHAN. 56b. 47882. 57. 48507, 48608. 60. 47830. 61. 48584.

RANGE IN CHINA (cf. Piippo 1990): Shaanxi, Sichuan, Taiwan, Hunan. New for Hunan.

TOTAL RANGE (Bischler 1979): As 2: Chi Ja Ko Tai; As 3: In Ne Pak; As 4: Phi. Map: Bischler 1979: 44 (Carte 3).

### *Asterella* P. Beauv. 1805

The thallus is dichotomously branched, often rosette-like, having innovations beneath or lateral-ventral branches. Dorsal cells are often thin-walled, pores are simple, air-chambers large and often dorsally visible. The ventral scales usually have one appendage. The archegonia are surrounded by a pseudoperianth. Twelve species have been reported from China (Zhu 2006).

### *Asterella khasyana* (Griff.) Pandé *et al.* Fig. 1

J. Hattori Bot. Lab. 11: 7. 1954 ('*khasiana*'). *Octokepos khasyanum* Griff., Not. Plant. Asiat. 2: 343. 1849.

DESCRIPTION: Long (2006c).

ILLUSTRATION: Pandé *et al.* (1954: 5, text-fig. III).

*Asterella khasyana* and other *Asterella* taxa occurring in China were discussed by Piippo (2010). The species is recognized by the delicate and thin thallus, ca 1–3 mm wide occurring in dense mats, regularly dichotomously branched without ventral shoots borne laterally, with dorsal surface flat, areolate in curved rows towards margins, air pores surrounded by 5–7 radial rows in rings, and ventral scales purplish and slightly overlapping with a single lanceolate acute appendage (see Long 2006c).

HABITATS AND SUBSTRATES IN HUNAN. *Asterella khasyana* was collected only in two localities in the warm temperate zone in Hupingshan. It grows in secondary forests (*Distylium*, *Euryoco-*

*rymbus*, *Ligustrum*, *Lonicera*, *Machilus*, *Paliurus*, *Pteroceltis*, etc.) at 390–550 m (Fig. 1). Substrates: on sand on wet brook side (2), as well as on humus on cliff (7), on sandy forest slope (1), on cliff (1). Frequency in Hunan: Very rare (2/209).

RANGE IN HUNAN: HUPINGSHAN. 57. (Piippo 2010), and 48628a. 58.

RANGE IN CHINA (Piippo 1990): Sichuan, Yunnan, Hunan.

TOTAL RANGE (Long 2006c): As 2: Chi; As 3: Bhu Tha Ne Pak In; As 4: Ind Phi. Map: Long (2006c): 167 (fig. 41).

### *Reboulia* Raddi 1818

The genus is monotypic.

### *Reboulia hemisphaerica* (L.) Raddi (Fig. 2)

Opusc. Sci. 2: 357. 1818. *Marchantia hemisphaerica* L., Spec. Plat. Ed. 1: 1138. 1753.

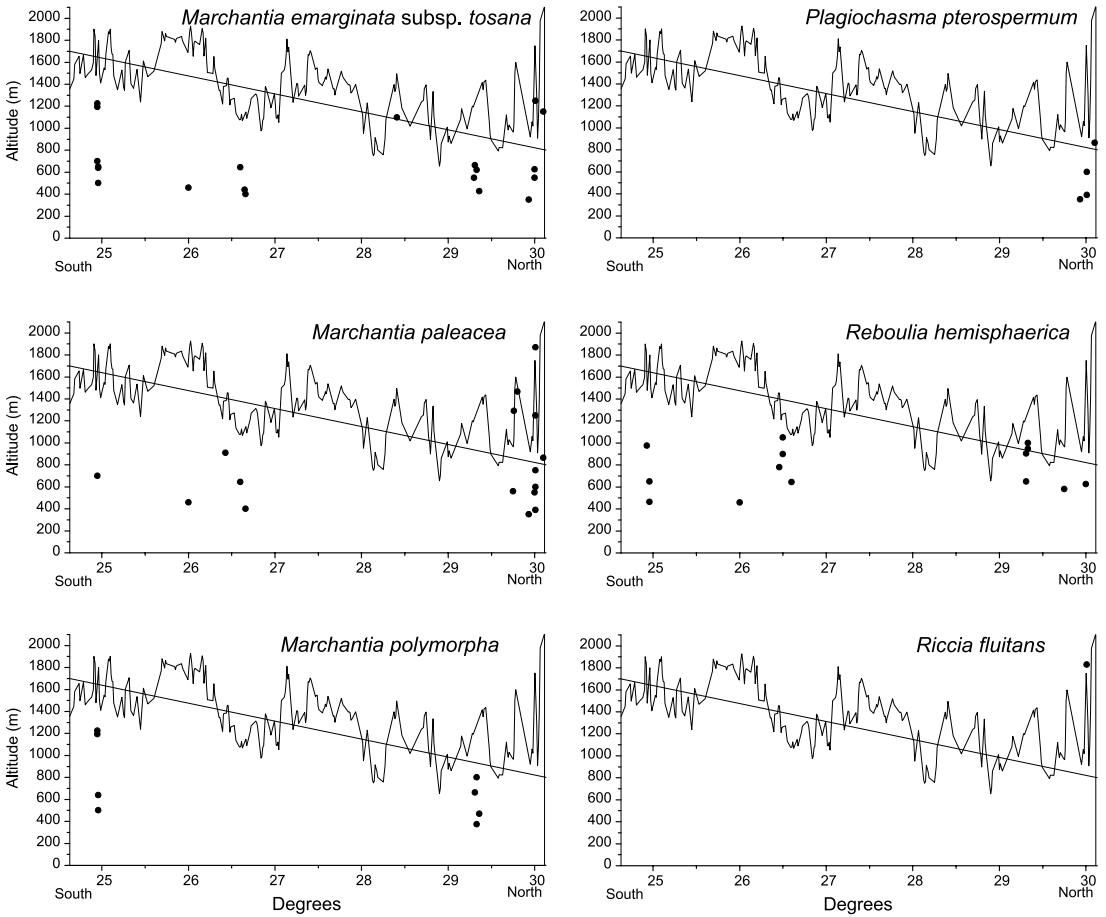
DESCRIPTIONS: Paton (1999), Damsholt (2002).

ILLUSTRATIONS: Inoue (1976: 147, pl. 73), Piippo (1988: 104, 105, figs. 93–h, 10), Paton (1999: 569, fig. 287), Lin (2000: 341–342), Damsholt (2002: 710, pl. 268).

The thallus of *Reboulia hemisphaerica* is leathery, firm, dull, light green, dichotomously branched, without tuberous apices, usually with narrow purplish margins that curve inwards when dry. Epidermal cells are thin-walled but with bulging trigones; pores are simple and slightly elevated. Usually the dorsal surface seems smooth, lacking any indication of areolation. The radial walls of epidermal pores are usually strongly thickened. The ventral scales are large, obliquely lunate, rectangular, on each side usually 1–2 slender and acuminate appendages.

*Reboulia* differs from *Plagiochasma* by the apical position of carpocephala; in *Plagiochasma* they are dorsal on the thallus. However, when sterile, many *Plagiochasma* specimens may be difficult to separate from *Reboulia*. The best character seems to be the appendages of ventral scales: in *Reboulia* very narrow and delicate, not so in *Plagiochasma*.





**Fig. 2.** The altitudinal distribution of *Marchantia emarginata* Reinw. *et al.* subsp. *tosana* (Steph.) Bischler, *M. paleacea* Bertol., *M. polymorpha* L., *Plagiochasma pterospermum* Mass., *Reboulia hemisphaerica* (L.) Raddi and *Riccia fluitans* L. in Hunan. Oblique line – border of warm temperate and orotemperate zone.

**HABITATS AND SUBSTRATES IN HUNAN.** Nearly all collections were made in the warm temperate zone. It grows both in primeval and secondary evergreen forests and along trails surrounded by orchards and *Cunninghamia* plantations, in villages and fields, in open to full shaded sites at 330–1000 m (Fig. 2). Substrates: on humus on bank (7), humus on rock or stone (4), stone at road side (3), on cliff (2), clay (2), soil (1). Frequency in Hunan: rare (14/209).

**RANGE IN HUNAN:** BADAGONGSHAN. 39b. 48469. HUPINGSHAN. 59. 49750. SHUNHUANGSHAN. 51. He 1392, 1447. TAOUYUANDONG. 21c.

56044. 24. 56288. 31a. 56025 in *Wiesnerella denudata*. WULINGYUAN. 18e. 19d. 19e. 84. 58561. YUANKOU. 74d. 60851, 60873, 60878, 60892, 60893. 77b. 60537, 60544, 60562. 79b. 60715. YUNSHAN. Y9. He 426.

XINNING CO., along road side in Lang Shan National Forest Park, on clay. Warm temperate (subtropical zone), 30 Nov. 2001 He 1460.

**RANGE IN CHINA** (Piippo 1990): Known from many provinces.

**TOTAL RANGE:** Schuster (1992) and Dierßen (2001): Cosmopolitan.

**Marchantiaceae** (Bischl.) Lindley 1836

The thallus is differentiated, with compound air pores. The ventral scales are in 2 to 10 rows, with 1–3 appendages. The antheridia are on stalked receptacles; sporophytes on stalked receptacles with compound air pores and the stalk with 2–4 rhizoid furrows, pseudoperianths are present. Gemmae may be present.

**Marchantia** L. 1753

The thallus is dichotomously branched, ventral scales are in 4–10 rows, median scales with a large appendage that is usually basally constricted; laminar scales are conspicuous. Cup-shaped gemm cups (cupules) serve as asexual dispersal means. The genus has been extensively studied by Bischler (1984, 1998; Bischler-Causse 1989, 1993). The genus is easy to distinguish from other complex thalloids due to its distinctly visible areolation and gemma cups that usually are present. Nine species have been reported from China (Zhu 2006).

**Marchantia emarginata** Reinw. *et al.* subsp. **tosana** (Steph.) Bischler Fig. 2

Crypt. Bryol. Lichénol. **10**: 77. 1897. *Marchantia tosana* Steph., Bull. Herb. Boiss. **5**: 99. 1897.

DESCRIPTION: Bischler-Causse (1989).

ILLUSTRATIONS: Bischler-Causse (1989: 200, 202, figs 57, 58).

*Marchantia emarginata* subsp. *tosana* is distinguished on the basis of its fairly small size, usually *ca* 2.4–4.0 mm wide, thallus margins which are usually purplish, but may be hyaline in shadow, sometimes slightly crisped; dark median band on the dorsal surface may be present or absent. The appendage of median scales is variable in size, its marginal teeth are 1–3-celled and some of them are obliquely oriented. The archegoniophore has 5–13 truncate lobes.

HABITATS AND SUBSTRATES IN HUNAN. Most collections of *Marchantia emarginata* subsp. *tosana* came from the warm temperate zone. It grows in Elaeocarpaceae – Fagaceae – Lauraceae – Magnoliaceae – Staphyuraceae evergreen broad-

leaved forests, in evergreen – deciduous broad-leaved forests (*Emmenopteris*, *Rhamnus*, *Quercus*, *Diospyros*, etc.) and in mature *Cunninghamia lanceolata* dominated forests. It is often a part of road-side vegetation; also on limestone outcrops in open Karst landscape and even in *Amorfofphallus* and *Ipomaea batatas* and other fields and along river surrounded by arable land, in open to partially shaded, mesic to moist habitats, often on river or brook sides at 350–1300 m (Fig. 2). Substrates: on clay (7), humus (4), stone (3), cliff (2), soil (2), humus in cliff crevice (1), rock top (1). Frequency in Hunan: rather rare (20/209).

RANGE IN HUNAN: DAWESHAN. *DAW 15*. Vir-tanen 62350. HUPINGSHAN. *56b*. 47879, 47886. *58*. 47678, 47699, 47738, 47748. *59*. 49719, 49720. *65*. 49783. *66*. 47790. MANGSHAN. *3a*. *4b*. *8*. *9a*. SHUNHUANGSHAN. *SI*. He 1450. WULINGYUAN. *16b*. *17a*. *18c*. *19a*. YUANKOU. *77b*. 60743. *78b*. 60786. YUNSHAN. *Y9*. He 429, 450, 454. *Y17*. He 347, 352, 353. *Y18*. He 337.

RANGE IN CHINA (cf. Piippo 1990): known from S and SE parts of the country.

TOTAL RANGE (Bischler-Causse 1989): As 2: Chi Ja Tai; As 3: Tha Vi.

**Marchantia paleacea** Bertol. Fig. 2

Opusc. Sci. Bologna **1**: 242. 1817.

DESCRIPTIONS: Bischler (1984), Bischler-Causse (1989, 1993), Bischler & Piippo (1991), Lin (2000).

ILLUSTRATIONS: Bischler (1984: 16–19), Bischler (1986: 347, 349, figs 1: 1–11, 2: 7–12), Bischler (1989: 97, 99, 101, figs 23–25), Bischler & Piippo (1991: 284, fig. 4), Bischler-Causse (1993: 71, 72, figs 12, 13), Lin (2000: 239).

Typical characters for *Marchantia paleacea* are: no dark median band on dorsal surface, margins often crisped, median scales purplish; appendages ovate to orbicular, obtuse, acute or apiculate, purplish or orange or hyaline with purplish margins, margins crenulate or irregularly toothed. The cupules have ciliate lobes and papillae on the outer surface. The female receptacle is shallowly divided into 5–11 lobes; the lobes are rounded or truncate.

HABITATS AND SUBSTRATES IN HUNAN. *Marchantia paleacea* was collected both in the warm temperate and orotemperate zones in forests such as Elaeocarpaceae – Fagaceae – Lauraceae – Magnoliaceae – Staphyuraceae evergreen broad-leaved forest, evergreen – deciduous (broad-leaved) forest, mature *Cunninghamia lanceolata* dominated forest, secondary forest and young plantation forests. Many habitats were rather open such as roadsides, limestone outcrops, agricultural land and cliffs along roadside and along trail in shrub and *Miscanthus* dominated slope, *Amorfohallus* and *Ipomaea batatas* field and along river in valley surrounded by arable land, in sunny or partial to full shade, dry to wet sites, at 350–1880 m (Fig. 2). Substrates: on clay (10), humus (8), cliff (5), stone (3), outcrop (3), sand (3), soil (1). Frequency in Hunan: rather rare (17/209).

RANGE IN HUNAN: BADAGONGSHAN. 39a. 55773, 61563, 61600. 40a. 55618. 46. 48242. HUPINGSHAN. 56b. 47885. 57. 48628, 49991. 58. 47653. 60. 47840. 61. 48599, 49934A, 52246. 62. 47818. 66. 47789. 71. 47600. SHUNHUANGSHAN. S1. He 1421, 1446. S3. He 473. YUANKOU. 78b. 60782, 60778, 60780, 60782, 60783. YUNSHAN. Y9. He 427. Y17. He 348, 355, 370. Y18. He 340, 341, 344, 345, 346.

RANGE IN CHINA (cf. Piippo 1990): Jilin, Liaoning, Sichuan, Anhui, Yunnan, Guizhou, Hunan, Taiwan. New for Hunan.

TOTAL RANGE: Eur (Azores, northern Mediterranean); Am 1; Afr 1 (Algeria); As 1–5 (cf. Bischler-Causse 1989). Circumtethyan (Bischler & Piippo 1991). Map: Bischler (1986): 346 (map 1).

### *Marchantia polymorpha* L.

Fig. 2

Spec. Pl. ed. 1: 1137. 1753.

DESCRIPTIONS: Bischler (1984), Bischler-Causse (1989, 1993), Paton (1999), Lin (2000).

ILLUSTRATIONS: Bischler (1984: figs 1–4), Bischler-Causse (1989: 77, fig. 20), Bischler & Piippo (1991: 280, fig. 1), Bischler-Causse (1993: 46–47, figs. 4–5), Paton (1999: 573, 574, figs 290, 291), Lin (2000: 240–242).

*Marchantia polymorpha* is light green or yellowish green, slightly purplish, the margins of the thallus are crisped or crenulate, usually without distinct dorsal median band. The marginal scales usually extend beyond thallus margin; the median scales are hyaline or with some purplish. The appendage is orbicular or reniform, basally cordate, hyaline or with purplish border, margins with sharp unicellular teeth. The archegoniophore has 9–11 long lobes, antheridiophore 6(–10) short lobes. *Marchantia polymorpha* in Hunan was previously treated in Koponen *et al.* (2000). Long (2006b) confirmed the occurrence of three European subspecies throughout Western China, and with similar ecological preferences.

RANGE IN HUNAN (see Koponen *et al.* 2000; Fig. 2): MANGSHAN. 3a. 4a. 8. 9a. WULINGYUAN. 15c. 16c. 18c. 19c.

RANGE IN CHINA (cf. Piippo 1990): Common.

TOTAL RANGE (cf. Bischler-Causse 1989; Bischler & Piippo 1991): Subcosmopolitan.

### Ricciaceae Reichenb. 1826

The dorsal thallus with or without distinct pores, dorsal surface usually longitudinally grooved. The ventral scales are in 1 to 2 rows, minute or large, without appendages. Gametangia and antheridia without receptacles, antheridia immersed in the thallus, sporophyte without seta. Gemmae absent, vegetative reproduction by fragments or tubers.

### *Riccia* L. 1753

The thalli in *Riccia* are often rosette-forming. The antheridia and archegonia are scattered or in dorsal groove or depression, without involucre or scales. Epidermal pores are absent. Eighteen species of *Riccia* have been reported from China (Zhu 2006). The genus is very poorly studied for the country. Only *Riccia chinensis* Herz. is earlier reported from Hunan (Piippo 1990). It has not been detected since it was described by Herzog (Herzog in Nicholson 1930).

***Riccia fluitans* L.**

Fig. 2

Spec. Plant. Ed. 1: 1139. 1753.

DESCRIPTIONS: Paton (1999), Damsholt (2002).

ILLUSTRATIONS: Gao &amp; Zhang (1981: 197, fig. 85: 1–4), Paton (1999: 584, fig. 296), Damsholt (2002: 771, pl. 285).

*Riccia fluitans* occurs in thin green patches, its branches are linear, flat, wider towards apex. In Hunan the branches were very narrow, only ca 0.3 mm.

RANGE IN HUNAN: HUPINGSHAN. 70. 47630, 47632 on humus in full shade along trail, in low forest and bush with *Pinus*, *Euonymus*, *Rosa* and *Miscanthus*, along trail in mesic, at altitude of 1800–1860 m (Fig. 2). Frequency site in Hunan: very rare (1/209).

RANGE IN CHINA (Piippo 1990; Zhu 2006): Shaanxi, Heilongjiang, Liaoning, Sichuan, Hunan. Jiangsu, Yunnan, Fujian, Zhejiang, Taiwan. New for Hunan.

TOTAL RANGE (Damsholt 2002): southern temperate, almost cosmopolitan.

## DISCUSSION

## FLORISTICS ELEMENTS

In an earlier paper (Koponen *et al.* 2004) a system to classifying the Hunanese species into distribution groups was established. On the basis of their zonal distribution in Hunan and their known total ranges, the taxa in this paper seem to divide in established groups as follows.

Holarctic, continuously or discontinuously circumpolar, boreal to temperate element

*Conocephalum conicum*  
*Conocephalum salebrosum*  
*Reboulia hemisphaerica*

Southeast Asian temperate to warm temperate element

*Conocephalum japonicum*  
*Marchantia emarginata* subsp. *tosana*  
*Plagiochasma pterospermum*

Southeast Asian warm temperate to subtropical element

*Asterella khasyana*  
*Wiesnerella denudata*

Pansubtropical – warm temperate element

*Dumortiera hirsuta*  
*Marchantia palaeacea*

Afro-Asian bicontinental element

*Plagiochasma appendiculatum*

*Marchantia polymorpha* has been classified as ‘subcosmopolitan’ (Bischler-Causse 1989; Bischler & Piippo 1991). However, in this study it was recorded only in the warm temperate zone in Hunan. Similarly, Schuster (1992) and Dierßen (2001) give *Reboulia hemisphaerica* as ‘cosmopolitan’. *Marchantia polymorpha* is partly a weedy species and may be ‘subcosmopolitan’. *Riccia fluitans* grows in wet habitats and therefore is absent from most arid areas. Damsholt’s (2002) statement ‘almost cosmopolitan’ maybe correct. We refer to our discussion on the use and misuse of the term ‘cosmopolitan’ to our earlier paper (Koponen *et al.* 2004: 31).

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