



## Unrecorded liverwort species from Korean flora III. New data on the distribution of *Mannia* Opiz (Marchantiophyta)

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**ABSTRACT:** While conducting a floristic study of Korean hepatics, we discovered two unrecorded species, which were collected from wind holes near the Donggang River, Korea. *Mannia fragrans* (Balb.) Frye & L. Clark and *Mannia androgyna* (L.) A. Evans are hereby reported for the first time in Korea. *M. androgyna* is characterized by pale grayish oil bodies in both the aerenchyma and basal tissue, and saccate spores with a conspicuous proximal disc. *M. fragrans* is characterized by a gynoeical segment with a whitish apical brush of scales, a commonly aromatic smell, and areolate spores with a conspicuous proximal disc. Two unrecorded species are described and illustrated based on Korean material.

**Keywords:** hepatics, Marchantiophyta, new record, Korean liverworts, *Mannia*

If we compare the flora of the Korean Peninsula with that of similar sized areas in Asia, it becomes obvious that Korea is one of the taxonomically richest regions among other temperate areas. To date, Korea houses over 330 species of liverworts and hornworts and hosts both subtropical species, widely present in the island of Jeju-do, and arctic-alpine taxa, such as *Scapania sphaerifera*, in the high elevations of Seoraksan and Jirisan (Choi, 2013). Despite the high number of recorded species, new records are still revealed almost every year with every new field study (Ellis et al., 2019). In this context, the present report continues the series of papers devoted to the description of new records of the Korean liverwort flora (Choi et al., 2012a, 2012b).

During a floristic study of Korean hepatics, we discovered two unrecorded species, collected from wind holes near the Donggang River, Korea. Wind holes, from which cool air blows out during the summer and mild air during the winter, have provided phytogeographically important refugia for cryophilous (cold-loving) boreal flora throughout the Holocene

period in southern latitudes and/or at low elevations, where the common vegetation features differ from those of the species located near wind hole openings (Kong et al., 2012). Recently, vascular and nonvascular plants have been studied in wind hole surroundings (Kim et al., 2016; Park, 2016) and several subalpine plants, such as *Cystopteris fragilis*, *Rosa koreana*, *Vaccinium vitis-idaea*, and *Woodsia hancockii* were discovered on wind hole openings located at elevations ranging from 100 to 600 m. In other words, they were encountered in areas generally occupied by cool to warm-temperate vegetation.

*Mannia* is a complex thallose liverwort genus distinct for being basi- or even calciphilous and for having an arctic-alpine distribution (Borovichev and Bakalin, 2013). Owing to these characteristics, *Mannia* is a rarity in East Asian amphipacific floras. Notably, only three species are present in Japan: *M. fragrans*, *M. levigata*, and *M. triandra* (Yamada and Iwatsuki, 2006), while there are 7–12 *Mannia* species worldwide (Schill et al., 2010; Söderström et al., 2016). Recently, Borovichev and Bakalin (2016) reported that *Mannia triandra* was new to

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the Korean liverwort flora.

In this study, we provide a description and habitat details of newly collected specimens in Korea. It is worth mentioning that two additional species of *Mannia* were found in nearly the same area as mentioned in the previous record of *Mannia triandra*, near the same wind hole opening. The present records confirm the high value of wind hole openings for taxonomic diversity preservation, therefore highlighting the considerable usefulness of such habitats for nature conservation in Korea. Additionally, the wind hole explored in the present study is the only limestone area suitable for the occurrence of arctic-alpine and oro-hemiarctic species in Korea, since there are no limestone outcrops in the Korean alpine belt, thus emphasizing the great importance of this site.

### Taxonomic Treatment

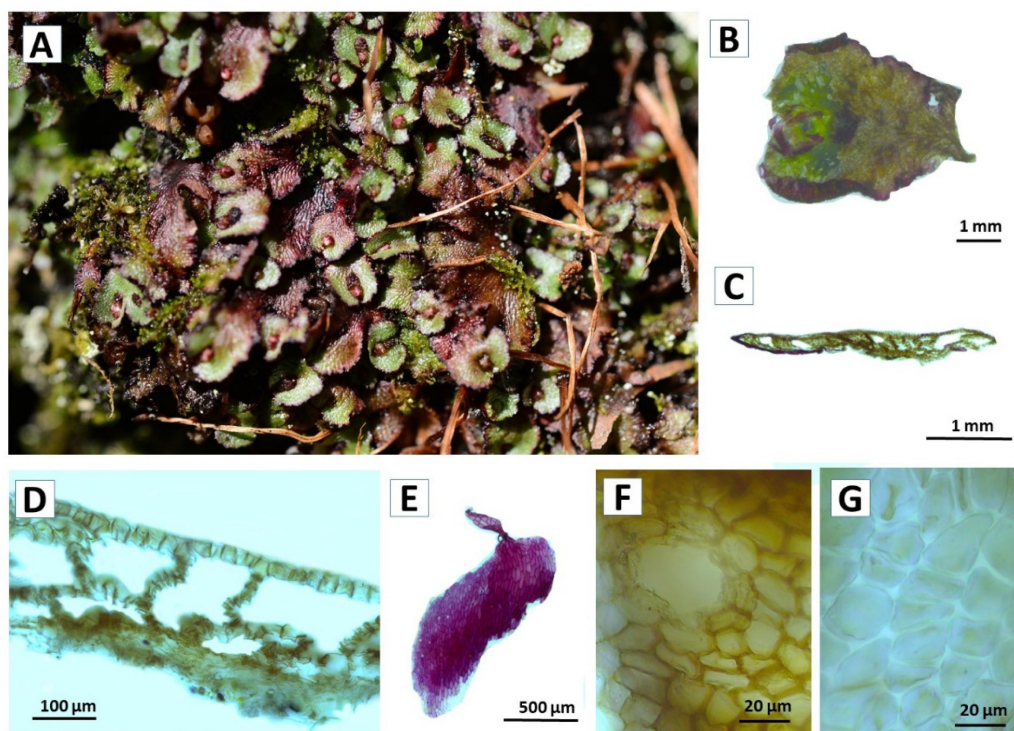
1. *Mannia androgyna* (L.) A. Evans, *Chronica Botanica* 4: 224, 1938 (Fig. 1).

*Marchantia androgyna* L., *Sp. Pl.* 1138, 1753.

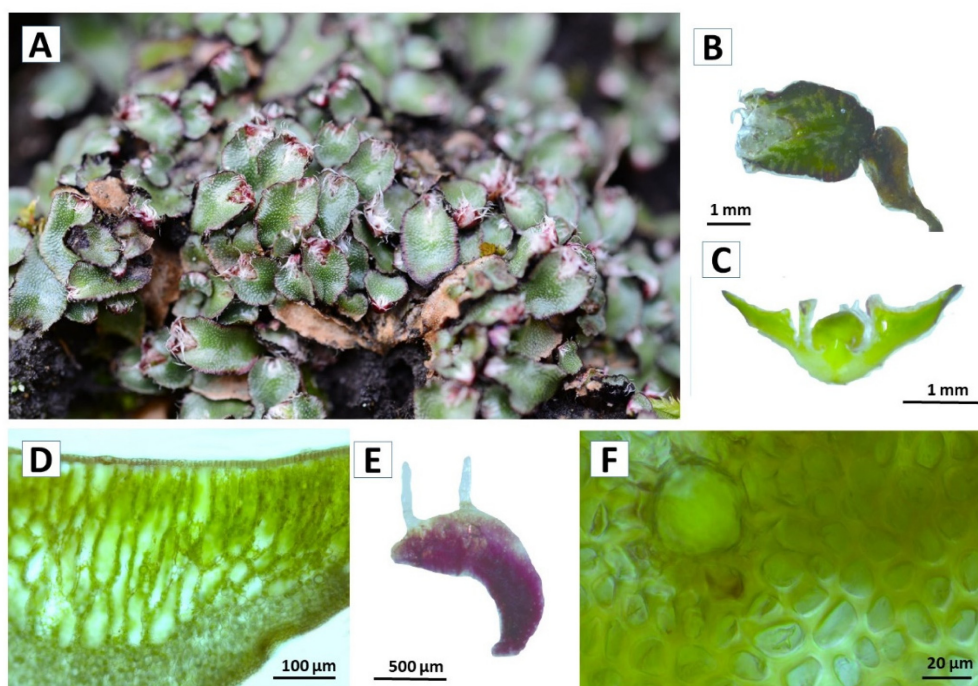
**Korean name:** Tu-gu-woo-san-i-kki (투구우산이끼).

Thalli thick, lobes 5.0–12.0 mm long, 1.2–3.2 mm wide, sparingly dichotomously branched, green, smooth, slightly

concave, brownish or whitish lacunose when disintegrating, thallus margins dark purple to slightly purple, slightly undulate; segments linear-lingulate to oblong; apex rounded, ventral scale appendages overlapping lobe apex. Dorsal epidermis colorless to rose tinged; cells 20.0–27.5 × 16.0–27.5 μm, with thin to slightly thickened walls, distinct trigones; pores simple, only slightly elevated above epidermis, 15.0–28.0 μm in diameter, surrounded by 2–3 concentric rings of 5–8 cells in each, cell walls thin or slightly thickened. Aerenchyma compact, occupying ca 0.3–0.5 of thallus height in the middle; air chambers small; ventral tissue occupying ca 0.5–0.6 of thallus height in the middle and absent in the wing, parenchymatous, consisting of thin-walled cells; oil-bodies lacking or present, pale-grayish. Rhizoids hyaline to purplish towards base. Ventral scales purple to reddish with sometimes pale purple margins, in two rows on each side of midrib, semicircular to broad-semicircular, 0.5–0.7 mm long and 0.5–1.3 mm wide; appendages 1–2, subulate, hyaline or reddish, margins irregularly serrate or weakly crenulate; appendage apex long to shortly acute to acuminate; oil bodies numerous, 10.0–25.0 μm in diameter. [Sexual condition paroicous or terminal autoicous. Antheridia situated on main thallus on other dichotomous bearing a female receptacle; androecial papillae in clusters or loosely dispersed, purplish. Gynoecea in apical



**Fig. 1.** *Mannia androgyna* (L.) A. Evans. **A.** Habitat. **B.** Plant. **C, D.** Cross section of thallus. **E.** Ventral scale with appendage. **F.** Air pore of dorsal epidermis of thallus. **G.** Median cells of dorsal epidermis of thallus.



**Fig. 2.** *Mannia fragrans* (Balb.) Frye et L. Clark. **A.** Habitat. **B.** Plant. **C, D.** Cross section of thallus. **E.** Ventral scale with appendage. **F.** Air pore and cells of median dorsal epidermis of thallus.

notch of terminal branches of thallus or borne on shorter ventral branches; stalk of receptacle 10–15 mm long, with single rhizoidal furrow. Archegonial scales hyaline to whitish, irregularly triangular-ovate or rounded. Carpocephalum hemispherical, yellowish green when young, mature turning green and often purple at margins; disc convex, 3–4-lobed; pseudoperianth lacking. Capsule large, globose (Borovichev et al., 2014)]. Spores yellowish brown to brownish, globose, 45.0–70.0  $\mu\text{m}$  in diameter, distal face distinctly saccate, bearing conspicuous hemispherical papillae. Elaters yellowish brown to straw colored, 110.0–210.0 mm long, 8.0–9.5 mm width at middle, trispiral.

**Habitats:** On shaded rocks near the wind hole in broad leaved deciduous forest.

**Distribution:** Korea, Japan, India, Europe, Africa.

**Specimens examined:** KOREA. Gangwon-do: Yeongwol-gun, Yeongwol-eup, Donggang River, elev. 353 m, 4 Oct 2019 leg. & det. S. S. Choi & V. A. Bakalin 1910004 (JNU; NIBR).

*Mannia androgyna* is a calcicolous species that occurs in the above-mentioned locality, together with *Reboulia hemisphaerica* (L.) Raddi and *Targionia hypophylla* L. This species is characterized by (1) pale grayish oil-bodies in both the aerenchyma and basal tissue, (2) paroicous or terminal autoicous inflorescence, and (3) saccate spores with a

conspicuous proximal disc.

The new Korean name given is “Tu-gu-woo-san-i-kki” and is based on the shape of the receptacle of the gynoeccium.

**2. *Mannia fragrans*** (Balb.) Frye et L. Clark, Univ. Wash. Publ. Biol. 6: 62, 1937 (Fig. 2).

*Marchantia fragrans* Balb., Mém. Acad. Sci. Turin, Sci. Phys. 10–11: 76, 1804.

**Korean name:** Teol-tu-gu-woo-san-i-kki (털투구우산이끼).

Thalli thick, fragrant, lobes 8.0–15.0 mm long, 2.5–3.8 mm wide, pure patches, sparingly dichotomously branched, frequently with both ventral and terminal innovations, dark green to greyish green, thallus margin purplish or brownish to reddish brown, slightly undulate, when dry strongly inrolled; segments linear lingulate, rather leathery, apex rounded, upper surface punctate, finely areolate. Dorsal epidermis cells hyaline, 15.0–22.5  $\times$  10.0–17.5  $\mu\text{m}$ , strongly collenchymatous, thick walled, convex trigones; oil cells absent; pore elevated above epidermis, surrounded by 2–3 concentric rings of 6–8 cells in each, cell walls thin or slightly thickened. Aerenchyma compact, occupying ca 0.35–0.50 of thallus height in the middle; ventral tissue occupying ca 0.5 of thallus height in the middle with scattered oil-cells. Rhizoids smooth and pegged,

hyaline, covering ventral surface of midrib of thallus. Ventral scales lunate, 2.0–2.8 mm long and 1.5–1.8 mm wide, imbricate, purplish; appendages 2–3 lanceolate linear, hyaline, acuminate, forming a projecting white apical brush. [Sexual condition dioicous or autoicous. Antheridia in circular sessile disks; androecia coarsely papillose. Gynoecia in apical of terminal branches or elongate segment; stalk of receptacle 10–15 mm long. Archegonial scales conspicuous cluster of whitish, dense cluster of similar scales. Carpocephalum hemispherical, 1.8–2.5 mm wide, shallowly 3–4 lobed. Capsule globose, thin walled, without thickenings Spores yellowish brown, 60.0–82.0 µm in diameter, distal face areolate, finely granulate. Elaters reddish brown, 190.0–225.0 µm long, 10.0–18.0 µm width at middle, 3–4 spiral (Schuster, 1992).]

**Habitats:** On shaded rocks near the wind hole in broad leaved deciduous forest.

**Distribution:** Korea, China, Japan, Europe, and North America.

**Specimens examined:** KOREA. Gangwon-do: Yeongwol-gun, Yeongwol-eup, Donggang River, elev. 353 m, 4 Oct 2019 leg. & det. S.S. Choi & V.A. Bakalin 1910005 (JNU; NIBR).

*Mannia fragrans* is characterized by (1) a gynoecial segment with a whitish apical brush of scales, (2) the absence of oil cells, (3) a commonly aromatic (cedar oil) smell, (4) antheridia forming a slightly upraised disc, and (5) areolate spores with a conspicuous proximal disc. In Korea and the rest of East Asia, this species is easily distinguished from the other *Mannia* species by its whitish apical brush of scales.

The new Korean name given is “Teol-tu-gu-woo-san-i-kki” and is based on the shape of the gynoecium receptacle with archegonial scales.

### Key to the *Mannia* in Korean Peninsula

1. Gynoecial thallus with whitish apical brush of scales; plants aromatic (smell of cedar oil) ..... *M. fragrans* 털투구우산이끼
1. Gynoecial thallus without whitish apical brush of scales; plants not aromatic ..... 2
  2. Thallus margins dark purple to slightly purple with firm epidermis; spores distal face distinctly saccate ..... *M. androgyna* 투구우산이끼
  2. Thallus margins pale green to grayish with lacunose epidermis; spores distal face incompletely to distinctly areolate ..... *M. triandra* 별투구우산이끼

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### Conflict of Interest

The authors declare that there are no conflicts of interest.

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