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## *Frullania azureomontana* – a new species from Jamaica (Marchantiophyta: Frullaniaceae)

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Fig. 1. View from Mavis Bank to Blue Mountain Peak, Dec. 2013

**Abstract:** Schäfer-Verwimp, A. & Winter, G. (2022): *Frullania azureomontana*, a new species from Jamaica (Marchantiophyta: Frullaniaceae). *Frahmia* 30:1-12. \*

*Frullania azureomontana* is described and illustrated from elfin forest of the Blue Mountains of Jamaica. It stands out by distant lobules (subgen. *Diastaloba* s.l.), relatively small size, and dispersed ocelli in leaf lobes, gynoecia and androecia. The only member of subgen. *Diastaloba* in the Neotropics with dispersed ocelli in leaf lobes so far known is *Frullania vitalii* Yuzawa & S.Hatt. from Brazil which differs in several details: smaller size, leaves and branches slightly incurved when dry, differently shaped underleaves often with 1-2 blunt teeth along outer margin, ocelli also in leaf lobules, and different ecology. For *Frullania vitalii*, ocelli are firstly reported from underleaves and androecia.

**Key words:** new species, endemism, ocelli, *Diastaloba*, *Frullania vitalii*

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## 1. Introduction

Jamaica with a land mass of 10,991 km<sup>2</sup> is the third largest island in the Caribbean. Originally Jamaica was completely forested (Berke & Beatly 1995) supporting great biodiversity. However, large areas have been cultivated, and despite recent conservation efforts, forest clearance and fragmentation is going on remaining a significant threat for biodiversity loss.

The bryophyte flora still remains poorly known in comparison to the vascular flora. The earliest overview of the bryophytes of Jamaica was published by Lunan (1814) who mentioned 70 bryophytes, (40 species of mosses and 30 species of liverworts). Nearly 200 years later, Söderström et al. (2011) reported 332 taxa in 314 species of liverworts and hornworts, and provided an overview of the hepaticological exploration and literature. Finally, Schäfer-Verwimp & van Melick (2016) raised the number of known liverwort and hornwort species to 367. The two last new species described from Jamaica are *Lepidolejeunea grandiocellata* Schäf.-Verw., Bechteler, van Melick, M.A.M.Renner & Heinrichs, including the new subgenus *Caribeolejeunea* Schäf.-Verw., Bechteler, van Melick, M.A.M.Renner & Heinrichs (Schäfer-Verwimp et al. 2017) and *Cheilolejeunea azureomontana* C.J.Bastos & Schäf.-Verw. (Bastos & Schäfer-Verwimp 2017). Nevertheless, Jamaica and the Caribbean in general, remain undercollected.

When searching for *Leiolejeunea grandiflora* A.Evans at its type locality in the Blue Mountains (Schäfer-Verwimp et al. 2014), a small portion of an inconspicuous species of *Frullania* admixed to a *Drepanolejeunea* collection was found and separated as it was unknown to the first author. A recent detailed study of two specimens, however, convinced us, that there is an undescribed species at hand which we describe as follows.

## 2. Description of the new species

*Frullania azureomontana* Schäf.-Verw. & Gerh. Winter, sp. nov.

Figs. 2, 4, 6, 8, 10, 12, 14, 16, 17.

*Frullania* subgen. *Diastaloba* s.l.

**Diagnosis:** Dioicous, plants small, 1.2-2 cm long, 1 mm wide. Leaves, gynoecia and androecia with scattered ocelli. Central leaf cells elongate with large, often confluent trigones. Lobules distant from the stem, (sub-)parallel to the stem or obliquely to nearly horizontally spreading, twice as long as wide. Underleaves distant, flat, bilobed to 0.3-0.4, lobes acute, margins smooth.

**Etymology:** the new species is named after its type locality, the Blue Mountains of Jamaica (fig. 1).

**Type:** JAMAICA, St. Thomas: Blue Mountains, Weg zwischen Portland Gap und Blue Mt. Peak, Elfinforest entlang Kammweg, epiphytisch; 2150 m; WGS84: 18°02,8' N, 76°35,1' W, 15. Dez. 2013, leg. A. Schäfer-Verwimp 35391/D, mit H. van Melick [with androecia] (Holotype: JE!; isotype: FR!)

**Plants** olive green to brownish in herbarium, in sparse mats appressed to bark of young tree. **Stems** 1.2-1.5(-2) cm long, 100-120(-135)  $\mu\text{m}$  in diameter, in cross section rounded, 7-8 cells high, cells firm-walled, 15 x 20  $\mu\text{m}$ , marginal cells slightly smaller than central ones, clearly corticated, 12 x 15  $\mu\text{m}$ ; plants with leaves 1 mm wide, irregularly pinnately to bipinnately branched, branches obliquely spreading or in right angles, 1.5-3.5 mm long, occasionally branched again (short branches with androecia).



Fig. 2. Habitus, dorsal view of *Frullania azureomontana* (from A. Schäfer-Verwimp 35404/A)



Fig. 3. Habitus, dorsal view of *Frullania vitalii* (from A. Schäfer-Verwimp 13629)

**Lobes** of stem leaves contiguous to (sub-)imbricate,  $\pm$  horizontally spreading, nearly flat to slightly convex (if seen from dorsal) (fig. 2), dorsally extending hardly to 1.5 x stem width beyond the farther edge of stem, dorsal base cuneate, apex broadly rounded, occasionally with an inconspicuous 1-celled apiculus, 650  $\mu\text{m}$  long, 470-480  $\mu\text{m}$  wide, basal leaf cells slightly larger than median cells, 20 x 25  $\mu\text{m}$ , with large knot-like trigones, median leaf cells elongate, 14-16  $\mu\text{m}$  wide, 20-30  $\mu\text{m}$  long, with large knot-like and often confluent trigones (fig. 6), intermediate thickenings lacking or rarely one, marginal cells smaller, usually (sub-)quadrate, (10-)12-14 x 14-16  $\mu\text{m}$ , with strong trigones; 10-25 **ocelli** scattered per leaf lobe of same size as surrounding cells, frequently becoming unrecognizable in herbarium material due to degradation of the oil body within the ocellus.

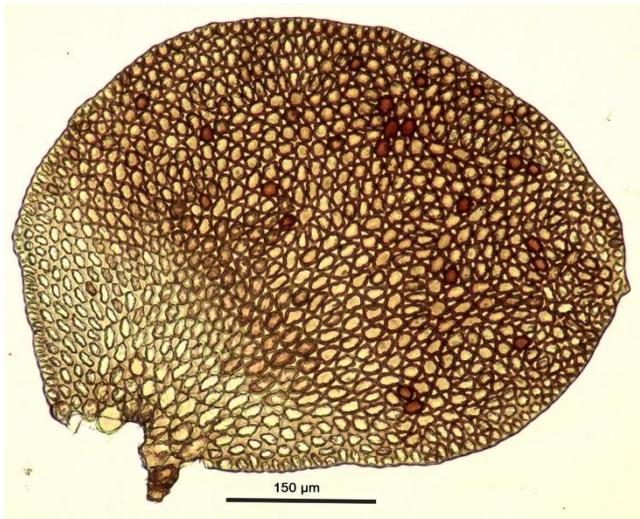


Fig. 4. Stem leaf of *Frullania azureomontana* (from A. Schäfer-Verwimp 35391/D)

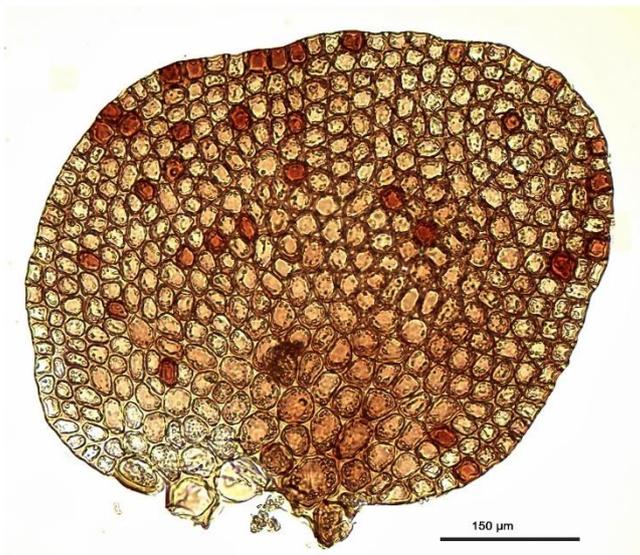


Fig. 5. Stem leaf of *Frullania vitalii* (from A. Schäfer-Verwimp 13629)

**Branch leaves** often conspicuously smaller, especially in median and apical part of the branch where the lobules are sometimes reaching the apical margin of leaf lobes or even beyond. In some branches, only the median part has smaller leaf lobes. No typical microphyllous branches have been seen.

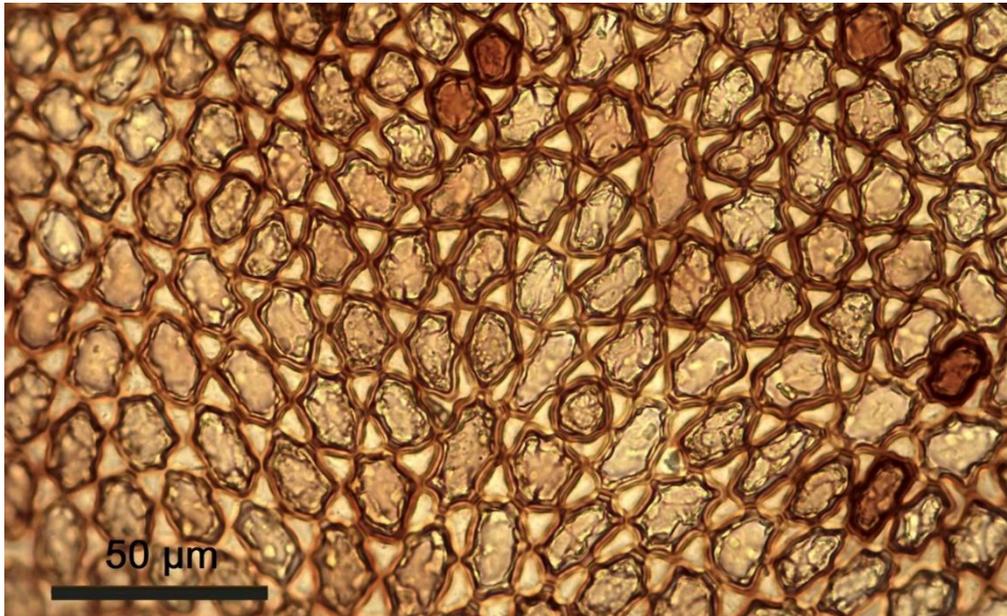


Fig. 6. *Frullania azureomontana*, central leaf cells of stem leaf (from A. Schäfer-Verwimp 35391/D)

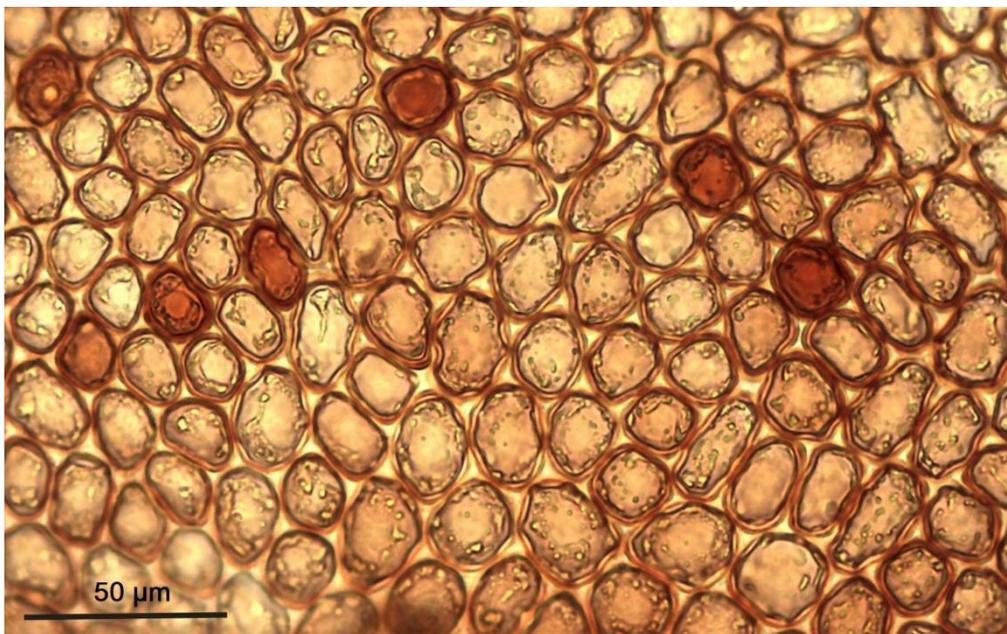


Fig. 7. *Frullania vitalii*, central leaf cells of stem leaf (from A. Schäfer-Verwimp 13629)

**Lobules** distant from the stem, 220-225  $\mu\text{m}$  long, 100-105  $\mu\text{m}$  wide, 2x longer than wide, nearly parallel to the stem or obliquely to nearly horizontally spreading, in branches 200  $\mu\text{m}$  long, 100  $\mu\text{m}$  wide, cells elongate, 10 x 20  $\mu\text{m}$ , with strongly thickened wavy walls and knot-like trigones, crenulate along opening, opening asymmetrical with incision reaching about 0.3-0.4 of lobule length, usually with a large, nearly isodiametrical cell at both ends of opening; beak absent. No laminate lobuli seen. **Stylus**  $\pm$  filiform to narrowly triangular, usually with dilated base, 2-4 cells wide at base, 2-4(-5) cells long, crowned by a hyaline papilla.

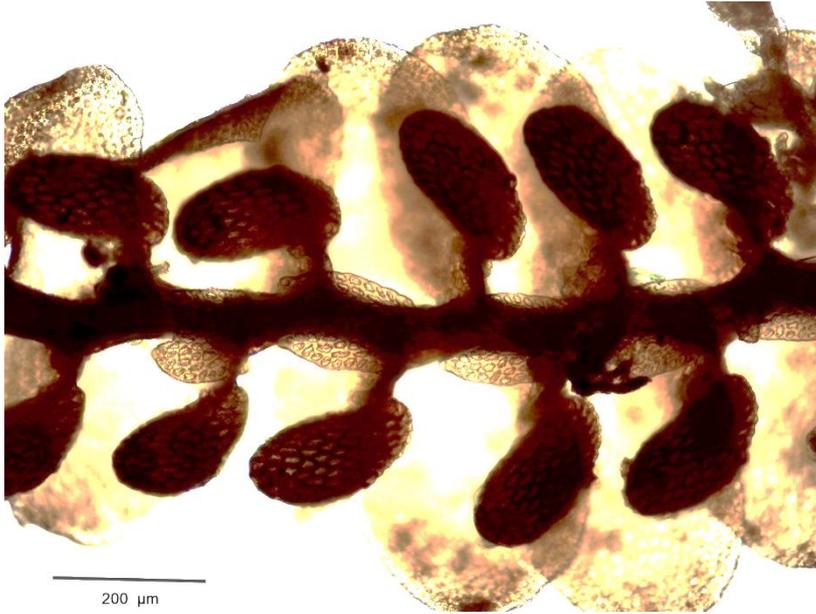


Fig. 8. Lobules of *Frullania azureomontana* (from A. Schäfer-Verwimp 35391/D)

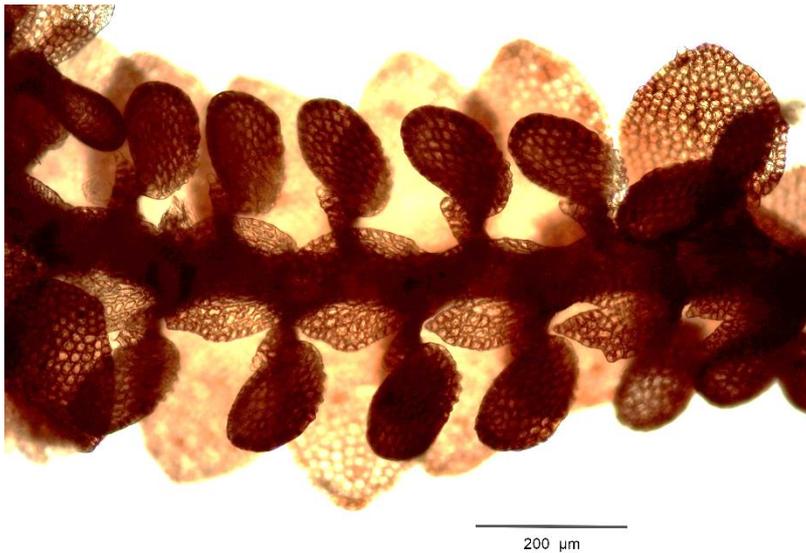


Fig. 9. Lobules of *Frullania vitalii* (from A. Schäfer-Verwimp 13629)

**Underleaves** distant, narrowly ovate to subrectangular, (150-)160-180(-200)  $\mu\text{m}$  wide, 200-230  $\mu\text{m}$  long, 1.5-2 x stem width, margins entire, flat, bilobed to 0.3-0.4, lobes acute, 4-6 cells wide at base, ending in 1-2 superposed cells, sinus narrowly rounded, cells similar to central leaf cells, insertion line nearly horizontal to slightly arched (fig. 10).

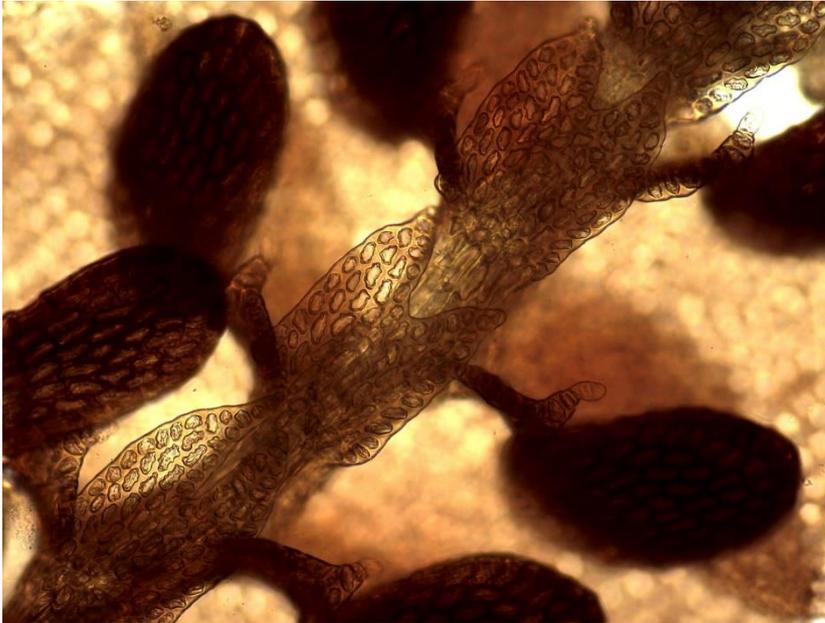


Fig. 10. Stem underleaves of *Frullania azureomontana* (from A. Schäfer-Verwimp 35391/D)

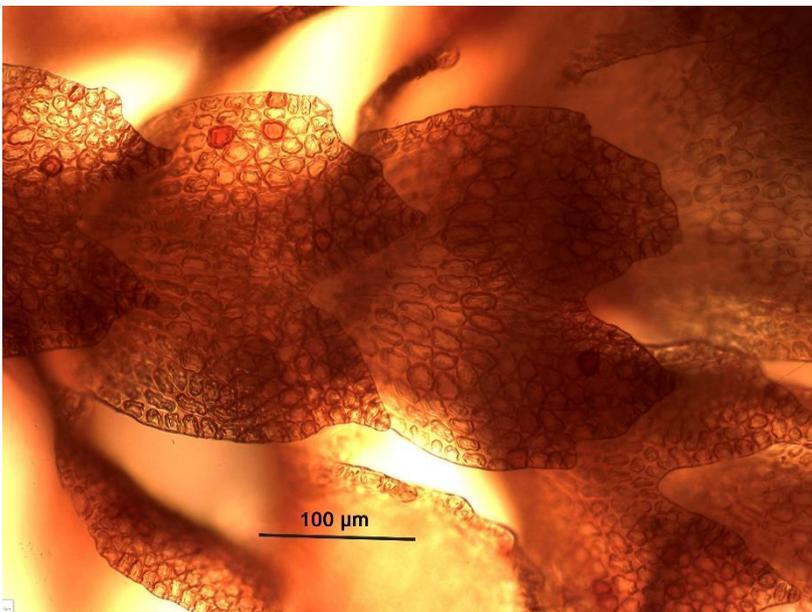


Fig. 11. Stem underleaves of *Frullania vitalii* (from A. Schäfer-Verwimp 13629)

**Hemiphyll** similar to underleaves, but slightly smaller and more deeply divided ( $1/2 - 2/3$ ) associated with a lobule, followed by a double lobule.

**Dioicous. Androecia** intercalar on long branches or terminal on very short branches, with 2-3 pairs of bracts, 0.6-0.9 mm wide, 0.5-0.7 mm long, bracts and bracteoles smooth, the basal bracteole sometimes followed by a suprabasal one, ca. 5-10 dispersed ocelli in bracts and bracteoles; one male plant seen with nine androecia, five terminal and four intercalar.



Fig. 12. Androecia of *Frullania azureomontana* (from A. Schäfer-Verwimp 35391/D)

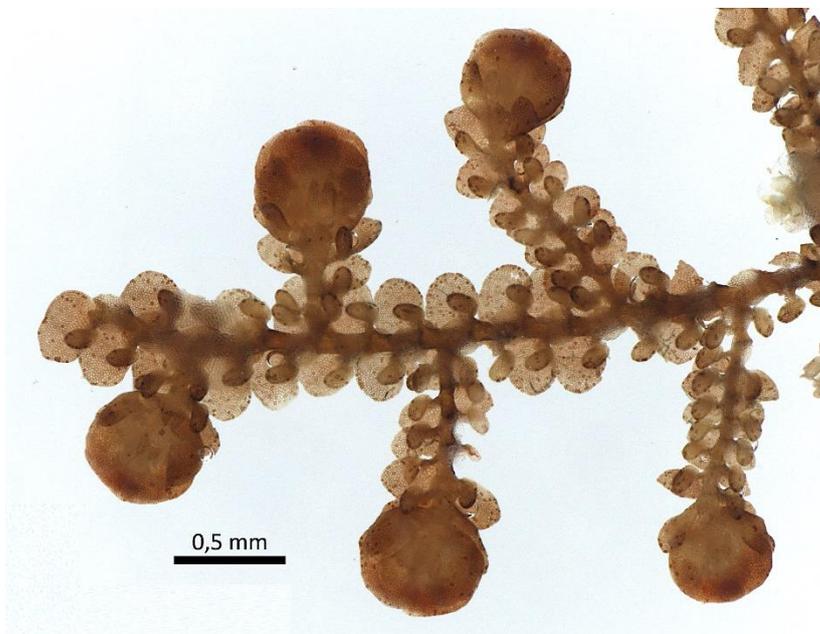


Fig. 13. Androecia of *Frullania vitalii* (from A. Schäfer-Verwimp 14987/A)

**Gynoecium** (described from paratype collection A. Schäfer-Verwimp 35404/A) consisting of 3-4 pairs of bracts and bracteoles, bract lobe narrowly ovate-lanceolate, 280-290  $\mu\text{m}$  wide and 810-820  $\mu\text{m}$  long, upper two third irregularly coarsely dentate-lobate-ciliate, teeth up to 16 cells long and 2-4 cells wide at base, central lobe cells often irregular in shape but usually elongate (1.5-2.5(-3)x as long as wide) with strong knot-like and confluent trigones, the cell lumen often appearing star-like, trigones much less pronounced in lower third of lobe. Bract lobule wide ovate to nearly rounded from a narrow base, 530-540  $\mu\text{m}$  wide and 790-800  $\mu\text{m}$  long, irregularly dentate-lobate at upper margin only, cells similar as in bract lobe. Bracteole very deeply divided into two lanceolate lobes, 3(-4) cells from sinus to base, the lobes 620-630  $\mu\text{m}$  long and up to 200  $\mu\text{m}$  wide, margins and cells similar as in bract lobe. Both bracts and bracteoles with ca. 5-15 dispersed ocelli.



Fig. 14. Left: young gynoecium of *Frullania azureomontana* (from A. Schäfer-Verwimp 35404/A), right: gynoecium with perianth of *Frullania vitalii* (from A. Schäfer-Verwimp 33753)

**Vegetative reproduction** not seen

**Distribution and habitat:** *Frullania azureomontana* seems to be endemic to Jamaica and is so far known only from the summit region of the Blue Mountains between 2150 and 2250 m above sea level. It is growing in single plants or loose mats epiphytic in elfin forest, creeping between *Drepanolejeunea anoplantha* (Spruce) Steph., *D. valiae* Bischl., *Harpalejeunea* spec. (aff. *subintegra* A.Evans), and *Leiolejeunea grandiflora* A.Evans as well as several small species of *Bazzania* and *Plagiochila* growing nearby at the same tree. The paratype collection has been separated from a collection of *Plagiochila heterophylla* Lindenb. ex Lehm., *Drepanolejeunea anoplantha*, *D. araucariae* Steph., a small amount of *Microlejeunea* sp. (aff. *capillaris* / *colombiana*) and *Leiolejeunea grandiflora* were associated, too.



Fig. 15. Innermost young bract (left) and bracteole (right) of *Frullania azureomontana* (from A. Schäfer-Verwimp 35404/A)

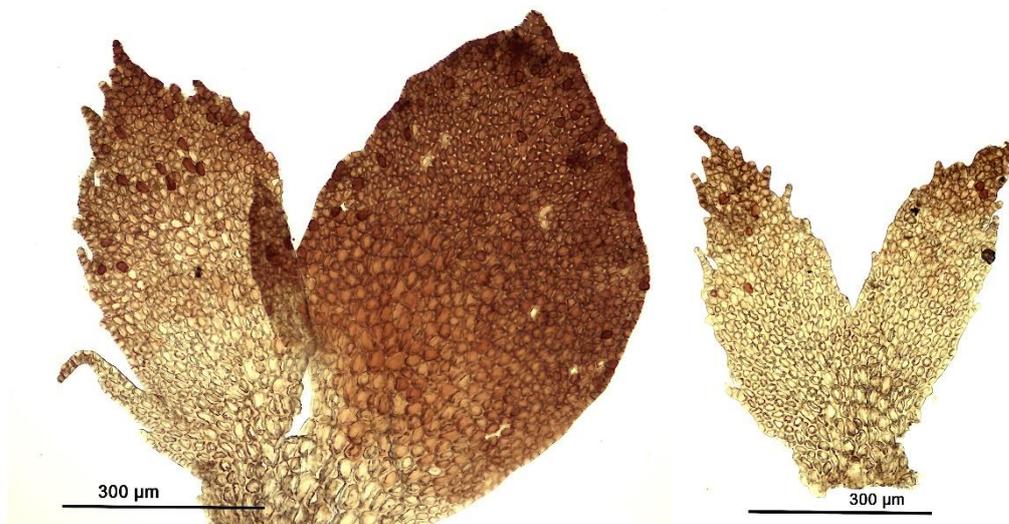


Fig. 16. Innermost bract (left) and bracteole (right) of *Frullania vitalii* (from A. Schäfer-Verwimp 33753)

**Additional specimen examined (Paratype):** JAMAICA, St. Thomas, Blue Mountains, Weg zwischen Portland Gap und Blue Mt. Peak, Elfinforest im Gipfelbereich, epiphytisch; 2250 m; WGS84: 18°02,785' N, 76°34,770' W, 15. Dez. 2013, leg. A. Schäfer-Verwimp 35404/A, mit H. van Melick [with young gynoecia, perianth not yet developed] (JE!, FR!).

### 3. Discussion

*Frullania azureomontana* is unique in the following combination of characters: (1) small size of plants, stem with leaves 1 mm wide, (2) dispersed ocelli in leaf lobes, gynoecia and androecia, (3) lobules distant and widely spreading from the stem (*Diastaloba* s.l.), and (4) underleaves distant, flat, 1.5-2 x stem width with smooth margins. Because of the occurrence of dispersed ocelli and the distant lobules which are characteristic of subgen. *Diastaloba* (s.l.), the new species can only be confused with *Frullania vitalii* Yuzawa & S.Hatt. from Brazil. The latter one, however, may already be distinguished in dry condition as its leaves (and branches) are somewhat incurved ventrally giving the plants a more wiry appearance (stem with leaves 0.6-0.7 mm wide), whereas *F. azureomontana* has flat and somewhat larger stem leaves in dry condition (stem with leaves 1 mm wide) (figs. 2-3). If comparing fig. 4 with fig. 5, the slightly different shape of the leaf lobes is apparent, the leaf lobe of *F. vitalii* being shorter (ovate) to (sometimes) nearly rounded. The central leaf cells of *F. azureomontana* have even stronger bulging and confluent trigones than those of *F. vitalii* (figs. 6-7). The shape of the lobules seems to be rather similar (figs. 8-9), however, ocelli in lobules have been observed only in *F. vitalii*.

In *F. vitalii*, ocelli are only present in leaf lobes and lobules (Yuzawa & Hattori 1988), and Lima (2019) reported ocelli also in bracts, bracteoles and perianth; however, ocelli are also occurring in underleaves, as shown in fig. 11, firstly reported here based on the following specimen:

Brazil, Santa Catarina, Ilha de São Francisco, Mangrove-Vegetation, epiphytisch, 2 m, 3. Jan. 1991. Jan., leg. Schäfer-Verwimp & Verwimp 13629 (SP, JE, FR, GOET).

Ocelli in androecia are clearly visible in fig. 13, firstly observed in the following specimen:

Brazil, São Paulo, Litoral, Mangrove-Vegetation (*Rhizophora mangle* + *Laguncularia racemosa*) am Rio Vermelho zwischen Bertioiga und São Sebastião, epiphytisch, 2 m, 12. Oct. 1991, leg. Schäfer-Verwimp & Verwimp 14987/A (SP, JE, FR, GOET).

In underleaves of *F. vitalii*, ocelli may even faster disintegrate in herbarium than in other parts of the plant and are therefore easily overlooked. In *F. azureomontana* ocelli are present in leaf lobes, androecia, bracts and bracteoles, however, no ocelli have been seen in leaf lobules and underleaves. As shown in fig. 11 the shape of underleaves is clearly different, being  $\pm$  subquadrate and (often) with 1-2 blunt teeth along outer margin in *F. vitalii*, more narrowly ovate-rectangular and with smooth margin in *F. azureomontana* (fig. 10). Different cell areolation in underleaf cells is also obvious comparing fig. 10 with fig. 11.

Finally, gynoecia (fig. 14) and androecia, too, seem to be clearly different. The most striking difference is the much less deeply divided innermost bracteole of *F. vitalii* with 16-18 cells between sinus and base, whereas in *F. azureomontana* this bracteole is divided nearly to the base, leaving only 3(-4) cells between sinus and base (figs. 15-16). Androecia of *F. vitalii* are larger in comparison to the plant (wider than stem with leaves), with (3-)-4-5 pairs of bracts (2-3 pairs after Lima 2019), in *F. azureomontana* the androecia are hardly as wide as the stem with leaves, consisting only of 2-3 pairs of bracts. In both species, ocelli may occur in androecia (figs. 12-13).

The two species also differ in their ecology and distribution: *F. vitalii* is primarily a lowland to lower montane species in Brazil, often occurring in mangrove vegetation, known from sea level to 1200 m elevation (Lima 2019) whereas *F. azureomontana* is known only from elfin forest of the highest mountain in Jamaica at an elevation between 2150 and 2250 m.

Because of its overall morphological similarity with *Frullania vitalii* and its small size, our new species may also belong to subgenus "*Diastaloba* I" as outlined by Hentschel et al. (2009).

#### 4. Acknowledgments

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#### 5. Bibliography

- BASTOS C.J.P.; SCHÄFER-VERWIMP A. (2017) Three new species of *Cheilolejeunea* (Spruce) Steph. (Lejeuneaceae, Marchantiophyta) from the Neotropics. *Phytotaxa* **299**(1): 066-076. <https://doi.org/10.11646/phytotaxa.299.1.4>
- BERKE P.; BEATLEY T. (1995) Sustaining Jamaica's Forests: The Protected Area and Resource Conservation Project. *Environmental management* **19**: 527-546.
- HENTSCHEL J.; KONRAT M.J.VON; PÓCS T.; SCHÄFER-VERWIMP A.; SHAW A.J.; SCHNEIDER H.; HEINRICH J. (2009) Molecular insights into the phylogeny and subgeneric classification of *Frullania* Raddi (Frullaniaceae, Porellales). *Molecular Phylogenetics and Evolution* **52**: 142-156. <https://doi.org/10.1016/j.ympev.2008.12.021>
- LIMA E. (2019) *Frullania* Raddi (Frullaniaceae, Marchantiophyta) no Brasil. Dissertação de Mestrado, Univ. Federal Rural da Amazônia, Museu Paraense Emílio Goeldi, Belém, Pará. 205pp.
- LUNAN J. (1814) Hortus Jamaicensis, or a botanical description (according to the Linnean system) and an account of the virtues, & c., of its indigenous plants hitherto known, as also of the most useful exotics. St. Jago de la Vega Gazette, Jamaica, 538 pp. <https://ia800203.us.archive.org/34/items/hortusjamaicensi01luna/hortusjamaicensi01luna.pdf>
- SCHÄFER-VERWIMP A.; FELDBERG F.; DONG S.; VAN MELICK A.; PERALTA D.F.; SCHMIDT A.R.; SCHNEIDER H.; HEINRICH J. (2014). Towards a monophyletic classification of Lejeuneaceae III: the systematic position of *Leiolejeunea*. *Phytotaxa* **170**(3): 187-198. <http://dx.doi.org/10.11646/phytotaxa.170.3.4>
- SCHÄFER-VERWIMP A.; VAN MELICK H.M.H. (2016) A contribution to the Bryophyte flora of Jamaica. *Cryptogamie, Bryologie* **37**(3): 305-34. <http://doi:10.7872/cryb/v37.iss3.2016.305>
- SCHÄFER-VERWIMP A.; BECHTELER J.; VAN MELICK A.; RENNER M.A.M.; HEINRICH J. (2017) *Lepidolejeunea grandiocellata* sp. nov. (Lejeuneaceae, Porellales), a new leafy liverwort from the West Indies based on morphological and molecular evidence. *Cryptogamie, Bryologie* **38**(3): 253-263. <https://doi.org/10.7872/cryb/v38.iss3.2017.253>
- SÖDERSTRÖM L.; HAGBORG A.; VÁÑA J.; VON KONRAT M. (2011) Land of wood and water: A checklist of liverworts and hornworts of Jamaica. *The Bryologist* **114**(1): 67-91. <https://doi.org/10.1639/0007-2745-114.1.67>
- YUZAWA Y.; HATTORI S. (1988) A new *Frullania* species from Brazil. *The Journal of Japanese Botany* **63**(1): 30-32. [http://www.jjbotany.com/pdf/JJB\\_063\\_30\\_32.pdf](http://www.jjbotany.com/pdf/JJB_063_30_32.pdf)