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Original article

Synopsis of *Anomobryum* and *Bryum* (Bryaceae, Bryophyta) in Brazil

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ABSTRACT

Bryaceae is a species-rich moss family comprising ten genera and 660 species, with four genera and 54 species occurring in Brazil. *Bryum* is the largest genus, with 440 cosmopolitan species, while *Anomobryum* comprises 47 cosmopolitan species. Identifying taxa in Bryaceae is usually a difficult task, mainly due to the lack of the sporophyte in herborized specimens. This study aimed to provide a taxonomic treatment for the species of *Anomobryum* and *Bryum* in Brazil. Field expeditions were performed in all Brazilian biomes and States, with specimens deposited in the SP herbarium. We examined type specimens and collections from national and international herbaria, but mostly from the SP herbarium. Two species of *Anomobryum* and 18 species of *Bryum* were recorded for Brazil. Twenty species occur in the Atlantic Forest, with *Bryum pallescens*, *Anomobryum conicum* and *A. julaceum* being exclusives. *Bryum pallescens* is a new record for Brazil, and *B. riparioides* is a reestablished name also endemic to Brazil. We present the first description of the sexuality of *Bryum renauldii*. Ten taxa of doubtful occurrence and 20 excluded names for *Bryum* were reported for Brazil.

Keywords: acrocarpous mosses, Bryales, Bryophytes, neotropics, taxonomy.

Introduction

Bryaceae is a family of small to medium-sized, rarely large or robust, perennial acrocarpous mosses, tuft-forming or less often with subterranean stolons (Ochyra *et al*. 2008; Frey & Stech 2009). The morphology of leaves, cell-net type, limbidium thickness, costa excurrence, sexuality, capsule orientation, and peristome type are considerably variable (Frey & Stech 2009), resulting in the absence of morphological synapomorphies for Bryaceae (Pedersen *et al*. 2003). The family comprises ten genera and *ca*. 660 species with a cosmopolitan distribution, inhabiting several substrate types (Frey & Stech 2009). In Brazil, Bryaceae is represented by four genera (*Anomobryum*, *Brachymenium*, *Bryum*, and *Rhodobryum*) and 54 species (Costa *et al*. 2011).

Anomobryum is the third largest genus of Bryaceae, with 47 species occurring worldwide (Frey & Stech 2009), but most commonly found in montane regions (Spence & Ramsay 2002). The genus is characterized by plants with imbricate to julaceous and conspicuously concave leaves, with linear-vermicular median leaf cells (Allen 2002; Pedersen *et al*. 2003). There are only two non-endemic species of this genus in Brazil (*i.e.*, *A. conicum* and *A. julaceum*)

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(Costa *et al*. 2011). Most authors recognize *Anomobryum* as a distinct genus (Gradstein *et al*. 2001; Pedersen *et al*. 2003; Frey & Stech 2009; Holyoak & Köckinger 2010), while Spence (1987) and Ochi (1980, 1992, 1994) consider it as a subgroup of *Bryum*. Similarly, the lack of consensus on the monophyly of *Anomobryum* has led some authors to hypothesize its monophyly (Pedersen *et al*. 2003, 2007; Frey & Stech 2009), while others showed its paraphyly (Pedersen & Hadenäs 2003; Wang *et al*. 2011).

Bryum is one of the richest and most complex moss genera in the Neotropics and Brazil (Gradstein *et al*. 2001; Costa *et al*. 2011; Costa & Peralta 2015), with 440 cosmopolitan species (Cox & Hedderson 2003; Ochyra *et al*. 2008; Frey & Stech 2009). The morphology of *Bryum* is quite variable, with some authors (Frey & Stech 2009) defining this genus as containing green to occasionally red, pink or silver plants, with leaf margins typically limbate, di-, syn-, or autoicous, with usually pendulous capsules, oblong or pyriform to cylindric in shape, and with often complete peristome. In Brazil, only 32 species of *Bryum* are recorded (Costa *et al*. 2011).

In a first effort to stabilize the nomenclature of *Bryum*, several genera were segregated from its traditional circumscription, such as *Ptychostomum* (Spence 2005), *Gemmabryum* (Spence & Ramsay 2005), *Leptostomopsis* (Spence & Ramsay 2005), *Rosulabryum* (Spence 1996), and *Osculatia* (Ochyra *et al*. 2018). However, recent molecular studies do not support the monophyly of these segregates (Frey & Stech 2009; Hodgetts *et al*. 2020), and future molecular studies focusing on *Bryum s.lat*. are needed.

Morphological phylogenetic results are inconsistent with the recent molecular analyzes for Bryaceae and *Bryum* (Ochi 1980; Pedersen 2005; Cox & Hedderson 2003; Pedersen *et al*. 2003; Pedersen & Hedenäs 2003; 2005; Holyoak & Pedersen 2007). This inconsistency can be explained by the generic classification of Bryaceae being historically based on sporophyte characters, which has been proven homoplastic (Spence 1987). There, reliable taxonomic treatments must consider both gametophytic and sporophytic structures allied to molecular phylogenetic studies (Spence 1987).

The primary aim of the present study was to provide a taxonomic treatment for the species of *Anomobryum* and *Bryum* in Brazil. Secondary aims were to properly determine which species of *Anomobryum* and *Bryum* occur in Brazil, elucidate the distribution and ecology of all recorded species, and provide brief descriptions and illustrations for each species.

Material and Methods

Field expeditions were carried out in every Brazilian biome (vegetation classification system according to IBGE 2012) and State, with specimens deposited at the SP herbarium. We examined herborized specimens from the BM, HAS, HERW, NY, UB and SP herbaria (acronyms according to Thiers 2021). Specimens bearing sporophytes were given preference to ensure proper species identification. Due to the extensive number of examined specimens for most species, only two exsiccatae per state (one per municipality) were selected for the examined specimens lists. A complete list of all examined specimens in this study is provided as an supplementary material. About 40 specimens of *Anomobryum* and *ca*. 700 of *Bryum* were analyzed. Glycerin gelatin fixed slides were mounted (Kisser 1935) with the gametophytic and sporophytic morphological structures and analyzed using optical microscopy techniques. Photographs of the specimens were taken using optical and stereoscopic microscopes, and photographic plates were elaborated using Adobe Photoshop CS3 software (Adobe Systems Inc., San Jose, CA).

We consulted several Brazilian moss floras for name indexing (Yano 1981; 1989; 1995; 2010; Costa *et al*. 2011; Costa & Peralta 2015). The literature consulted to assist on species identification were Ochi (1980, 1981, 1982, 1992, 1994), Ochi & Mahu (1988), Allen (2002), and Shaw (1985, 1987), with emphasis on the protologues' descriptions. We consulted the TROPICOS (Missouri Botanical Garden) database for nomenclatural analysis, GBIF (www.gbif.org) for taxon distribution and collection analysis, Flora do Brasil 2020 (2021) for species checking, and JStor Global Plants (plants.jstor.org) for type specimens.

The classification system adopted here follows Frey & Stech (2009), which accepts both *Anomobryum* and *Bryum*. The synonymy for *Bryum* followed Ochyra *et al*. (2008) and Frey & Stech (2009), morphological delimitations for genera and species followed Allen (2002), and morphological terminology followed Malcolm & Malcolm (2006) and Gradstein *et al*. (2001). Only synonyms with type specimens from Brazil were listed. For synonyms from other regions, see the complete checklist in Ochi (1980, 1981, 1982). Complete morphological descriptions of all species from this study can be found in Allen (2002), Ochi (1980, 1981), Ochi (1994), and (Bartram 1952). Species distribution classification followed Valente & Porto (2006), considering rarely distributed species occurring in 1-4 States, moderately distributed species occurring in 5-9 States, and widely distributed species occurring in 10 or more States. Costa *et al*. (2011) and Costa & Peralta (2015) were used for verifying species records in the Brazilian States, and asterisks indicate first records for the States.

Results and Discussion

Bryaceae shows acrocarpous growth-form, central strand present, costa single and usually with stereid cells, smooth lamina cells, capsule exserted, peristome diplolepidous, and complete or reduced and common asexual reproduction (for a complete description see Allen 2002; Ochyra *et al*.

2008; Frey & Stech 2009). We observed a central strand in stem cross-section and stereids in leaf cross-section for all Brazilian *Anomobryum* and *Bryum* species.

Two species of *Anomobryum* were recorded in Brazil (*A. conicum* and *A. julaceum*) which corroborates previous studies (Costa *et al*. 2011; Costa & Peralta 2015). There are seven new records for the Brazilian States. Both species of *Anomobryum* have moderate distribution (*i.e.*, occurrence in 5 States), inhabit the Atlantic Forest, and occur exclusively in Brazil's Southern and Southeastern regions (also corroborating Costa & Peralta 2015). One species was excluded from Brazil.

We recorded 18 species of *Bryum* for Brazil. Compared with the literature, Costa & Peralta (2015) reported 19 species, while Costa *et al*. (2011) mentioned 32 species. This difference is due to the classification system adopted, which may consider *Bryum* either a broadly or narrowly circumscribed genus. Costa & Peralta (2015) also recorded for Bryaceae the genera *Imbribryum*, *Plagiobryum*, *Ptychostomum* and *Rosulabryum*, most of them segregated from *Bryum* (Lindberg 1863; Pedersen 2005; Spence 1996; 2005), while Costa *et al*. (2011) considered just *Bryum*. Based on the available molecular studies, only *Imbribryum* and *Plagiobryum* are currently accepted among the aforementioned genera (Frey & Stech 2009).

Thirty-seven new State distribution records are reported for *Bryum* in the present study. Regarding the species' geographical distribution, all recognized species occur in the Atlantic Forest. Of these, 13 also occur in the Cerrado, nine in the Caatinga, five in the Pampa, seven in the Amazon Forest, and only one in the Pantanal. Most species occur in Southern and Southeastern Brazil. According to Costa & Peralta (2015), the Atlantic Forest is the most diverse among the Brazilian biomes; and Southern and Southeastern Brazil also represent the richest regions in the country. *Bryum pallescens* is exclusive to the Atlantic Forest and is reported for the first time in Brazil. *Bryum riparioides* is a reestablished name and an endemic taxon to Brazil. Costa & Peralta (2015) cited five species of *Bryum* as endemic to Brazil, while we report only one. Here we present the first description of the sexuality of *Bryum renauldii*.

Three species of *Bryum* present a rare distribution pattern (*i.e.*, *B. arachnoideum*, *B. riparioides*, and *B. wrightii*), ten have a moderate distribution pattern (*i.e.*, *B. billarderii*, *B. capillare*, *B. dichotomum*, *B. huillense*, *B. limbatum*, *B. orthodontioides*, *B. pabstianum*, *B. pallescens*, *B. renauldii*, and *B. subapiculatum*), and five have a wide distribution pattern (*i.e.*, *B. apiculatum*, *B. argenteum*, *B. atenense*, *B. coronatum*, and *B. densifolium*).

Twenty taxa are excluded (*i.e.*, do not occur in Brazil) and ten are considered doubtful occurrences. Four new synonyms with type specimens from Brazil (*i.e.*, *B. brasiliense*, *B. leptocladon*, *B. oncophorum*, and *B. pseudomarginatum*) are proposed.

Taxonomic treatment

Key to the Brazilian genera of Bryaceae

1. Plants usually growing over tree barks; capsules erect to suberect; endostome teeth usually rudimentary or absent, with a fused membranous portion at base; cilia rudimentary or absent ..... *Brachymenium*
1'. Plants growing on soil or rocks, over tree barks (occasionally at the base of trees); capsules usually pendulous; endostome teeth present, conspicuous, divided from the base, usually with perforations in the median line; cilia usually well-developed 2
2. Stems not clearly visible, leaves julaceous (*i.e.*, imbricate) throughout, light green to yellowish-green, concave; costa sub-percurrent to short-excurrent; upper cells linear, vermicular to narrowly rhomboidal, thick-walled, basal cells rectangular to sub-quadrate, thin-walled, non-porose ..... *Anomobryum*
2'. Stems clearly visible, leaves julaceous or not (if julaceous, plants silvery-green), plane to rarely concave; costa sub-percurrent (rarely), percurrent to excurrent (short to long-excurrent); upper cells rhomboidal-hexagonal to narrowly rhomboidal (rarely), thin-walled, basal cells quadrate, sub-quadrate to rectangular, thin-walled, porose or not 3
3. Leaves usually less than 5 mm long, evenly spaced along the stem or congested in rosettes (rarely); costa in cross-section with well-developed stereids cells; subterranean stolons absent ..... *Bryum*
3'. eaves usually more than 7 mm long, evenly spaced along the stem (rarely) or congested in rosettes, rosettes sometimes distantly spaced between portions of the stem with reduced leaves; costa in cross-section with stereid cells reduced or absent; subterranean stolons usually present ..... *Rhodobryum*

Anomobryum Schimp., Syn. Musc. Eur. 382. 1860. *Bryum* Hedw. subgen. *Anomobryum* (Schimp.) Schimp., Syn. edn 2: 465. 1876. **Type species:** *Anomobryum julaceum* (Gaertn., Meyer & Scherb.) Schimp.

Plants small, slender, in erect, loose or gregarious tufts. Stems simple or branched. Leaves imbricate when wet or dry, ovate or oblong, inconspicuously decurrent; apices obtuse to rounded or broadly acute; margins entire to serrulate or crenulate near apex, plane to erect; costa subpercurrent to percurrent; upper cells linear-vermicular, rhomboidal or rhomboidal-hexagonal, thin- or thick-walled, basal cells differentiated from upper cells, broadly rectangular,

thin-walled. Setae elongate, straight. Capsules pendulous, horizontal to suberect; annuli well-developed; endostome and exostome complete as *Bryum*, variously reduced or rudimentary.

Key to the Brazilian species of **Anomobryum**

1. Leaf apex acute and apiculate, upper cells narrow rhomboidal to linear, costa strong, continuous toward the apex, percurrent to short-excurrent ..... 1. *Anomobryum conicum*
1'. Leaf apex obtuse, upper cells vermicular, costa weak, evanescent toward the apex, sub-percurrent ..... 2. *Anomobryum julaceum*

1. *Anomobryum conicum* (Hornsch.) Broth., Nat. Pflanzenfam. I(3): 563. 1903. *Bryum conicum* Hornsch., Fl. Bras. 1(2): 43. 1840. Type: Brazil. (Rio de Janeiro), ad latera rivolum prope Novo-Friburgum (Nova Friburgo), *Beyrich s.n.* (isotypes: BM000690964 image!, BM000690965 image!, BM000763055 image!, JE04004093 image!).

= *Bryum julaceoriparium* Müll.Hal., Index Bryol. Suppl. 65. 1900. *nom. nud*. Type: Brazil. Santa Catarina, Tubarão, *Ule 42* (lectotype BM000873729 image! designated by Ochi (1982); isolectotypes: BM000873728 image!, BM000873730 image!, SP032899!, G00265963 image!, G00265964 image!, GOET012339 image!, NY01178148 image!, PC0136770 image!, PC0136771 image!, PC0136772 image!, PC0136773 image!, PC0703584 image!, PC0703585 image!), *syn. acc.* Ochi (1982).

Fig. 1A-E.

Geographic distribution: Mexico, Central America, western and northern South America, northern Central Pacific (Allen 2002), and Brazil (moderate distribution: Minas Gerais, Paraná*, Rio de Janeiro, Rio Grande do Sul*, Santa Catarina, and São Paulo). Habitat: on soil, rock and slopes. It occurs in the Atlantic Forest; 10-1,700 m.

Plants small, up to 15 mm high, light green to dull green, dull-colored, imbricate, evenly spaced. Leaves concave, oblong to ovate; apices acute and apiculate; margins not bordered, entire to denticulate at apex, plane; costa strong, percurrent to short-excurrent; upper cells linear to narrow rhomboidal, thick-walled, basal cells rectangular to subquadrate, thin and firm-walled. Dioicous. Capsules orange-brown, pendulous to horizontal, cylindric to pyriform, neck slender; opercula conic-apiculate; exostome teeth pale yellow, slightly papillose, endostome hyaline, slightly papillose, segments well-developed, perforate, cilia 2-3, appendiculate.

Selected specimens examined: **BRAZIL. Minas Gerais:** Alagoa, 27/I/2019, *B.K. Canestraro 1527* (SP); Cristina, 25/V/1983, *O. Yano 7212* (SP); **Paraná:** Adrianópolis, 15/IX/2017, *B.K. Canestraro 1061* (SP); Candói, 16/I/2018, *B.K. Canestraro 1189* (SP); **Rio Grande do Sul:** Nova Roma do Sul, 14/IV/2010, *D.F. Peralta 10452* (SP); **Santa Catarina:** Grão Pará, 16/XII/2017, *B.K. Canestraro 1128* (SP); **São Paulo:** Campos do Jordão, 6/V/2012, *D.F. Peralta 12464* (SP); São Paulo, XI/1921, *F.C. Hoehne 600* (SP).

Anomobryum conicum has imbricate and concave leaves with acute and apiculate apex, entire to denticulate margins at apex, and strong, percurrent to short-excurrent costa. This species is very similar to *A. julaceum* due to their gametophyte and peristome aspect. However, the latter has leaves with obtuse apex, weak, evanescent and sub-percurrent costa, and vermicular and thick-walled upper cells (Fig. 1F-I). *Anomobryum conicum* is also similar to *Bryum apiculatum*, but this species has upper cells narrowly hexagonal to fusiform, basal cells enlarged, rectangular to quadrate, and axillary gemmae sometimes present (Fig. 2A-E).

2. *Anomobryum julaceum* (Schrad. ex G. Gaertn., B. Mey. & Scherb.) Schimp., Syn. Musc. Eur. 382. 1860. *Bryum julaceum* Schrad. ex P. Gaer tn., B. Mey. & Scherb., Oekon. Fl. Wetterau 3(2): 97. 1802. Protologue: Auf Dächern, Mauern und Balken. (not indicated?). non *Hypnum julaceum* (Schrad. ex G. Gaertn., B. Mey. & Scherb.) F. Weber & D. Mohr, Ind. Musci Plant. Crypt. (3). 1803 (Aug-Dec), *nom. inval.* latter homonym.

Fig. 1F-I

Geographic distribution: widespread in Pantropical and temperate areas (Allen 2002), Brazil (moderate distribution: Espírito Santo*, Minas Gerais, Paraná*, Rio Grande do Sul*, Santa Catarina*, and São Paulo*). Habitat: on soil, wet or dry slopes, rock, and cement. It is recorded mostly in high altitudes of the Atlantic Forest; 600-2,300 m.

Plants small, up to 25 mm high, light green to yellowish-green, bright-colored, imbricate, evenly spaced. Leaves concave, oblong to lanceolate; apices obtuse; margins not bordered, entire or serrulated towards the apex, plane; costa weak, evanescent, sub-percurrent; upper cells vermicular, thick-walled, basal cells rectangular, thin- and firm-walled. Dioicous. Capsules orange-brown, pendulous, pyriform, neck slender; opercula conic-apiculate; exostome teeth pale yellow, slightly papillose, endostome pale yellow to hyaline, slightly papillose, segments well-developed, perforate, cilia 2-3, appendiculate.

Selected specimens examined: **BRAZIL. Espírito Santo:** Iúna, 16/IX/1984, *D.M. Vital 11757* (SP); **Minas Gerais:** Itamonte, 10/VI/2015, *D.F. Peralta 17483* (SP); **Paraná:** Quatro Barras, 17/XI/2012, *D.F. Peralta 12729* (SP); **Rio Grande do Sul:** Bom Jesus, 9/I/2005, *R. Wasum 2382* (SP); São Francisco de Paula, 30/VIII/2017, *D.F. Peralta 21101* (SP); **Santa Catarina:** Campos Novos, 11/VII/1963, *P.R. Reitz 15366* (SP); Grão Pará, 16/XII/2017, *B.K. Canestraro 1127* (SP); **São Paulo:** Ibiúna, 26/XI/1995, *O. Yano 24549* (SP); Pindamonhangaba, 24/I/2019, *B.K. Canestraro 1494* (SP).

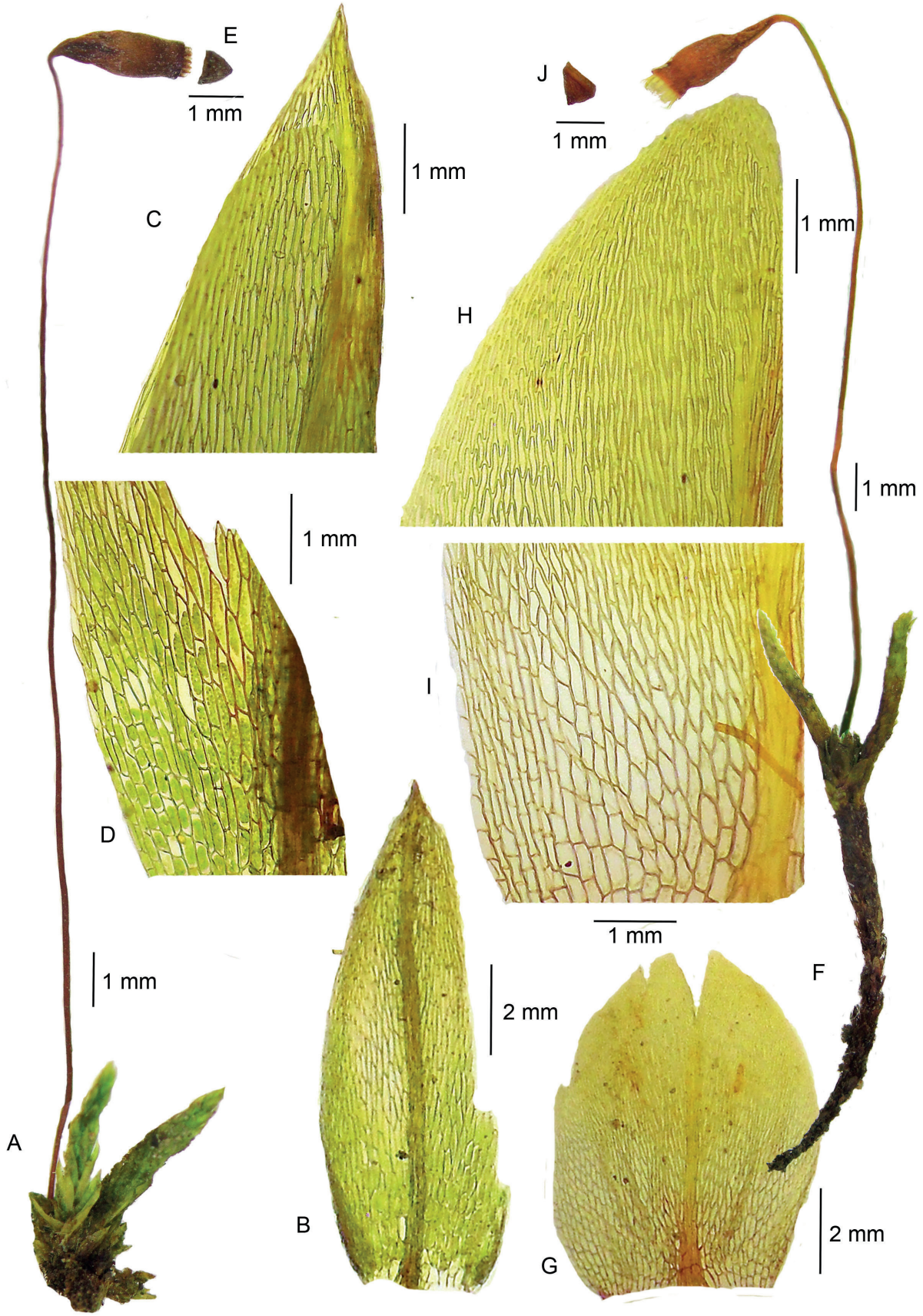

Figure 1. A-E. *Anomobryum conicum* (*B.K. Canestraro 1161*, SP). **A**. Habit, wet. **B**. Vegetative leaf. **C**. Vegetative leaf apex. **D**. Vegetative leaf base. **E**. Operculum. **F-I**. *Anomobryum julaceum* (*B.K. Canestraro 1129*, SP). **F**. Habit, wet. **G**. Vegetative leaf. **H**. Vegetative leaf apex. **I**. Vegetative leaf base.

It is a species with imbricate leaves, obtuse apex, not bordered margins, vermicular upper cells, and weak, evanescent and sub-percurrent costa. *Anomobryum julaceum* can be confused with *A. conicum* due to its imbricate leaves and small-sized (15 mm high). However, the latter has strong, percurrent to short-excurrent costa, acute apex and narrow rhomboidal to linear upper cells (Fig. 1A-E). The species is similar to *A. prostratum* (Müll.Hal.) Besch., but it is larger in size (10-80 mm high), its leaves are appressed-braided, with shorter, broader and rhomboidal-hexagonal upper cells, and firm- or thin-walled cells (Allen 2002). *Anomobryum prostratum* occurs in Mexico, Central America, western, northern, and southern South America (Ochi 1980; Allen 2002; see excluded species section).

Some European and Asian specimens of *A. julaceum* show deciduous flagelliform shoots or buds (Holyoak & Köckinger 2010) and occasional bulbils in the leaf axils (Koponen & Norris 1984), which was not observed in the Brazilian specimens.

Bryum Hedw., Sp. Musc. Frond. 178. 1801. **Type species:** *Bryum argenteum* Hedw.

= *Ptychostomum* Hornschuch., Flora 5: 64. 1822, *syn. acc.* Ochyra *et al*. (2008).

= *Rosulabryum* J.R. Spence, Bryologist 99: 222. 1996, *syn. acc.* Ochyra *et al*. (2008).

= *Gemmabryum* J.R. Spence & H.P. Ramsay, Phytologia 87: 69. 2005, *syn. acc.* Ochyra *et al*. (2008).

(Full synonymy in Ochyra *et al*. 2008).

Plants small to robust, in erect, dense or loose tufts. Stems simple or branched. Leaves erect to erect-spreading when dry, spreading when wet, ovate, ovate-lanceolate, lanceolate, oblong-lanceolate, ovate, elliptic, or orbicular, sometimes decurrent; apices obtuse, acute or acuminate, sometimes concave; margins serrate, or dentate near apex, plane, or recurved, entire; costa strong or weak, continuous or evanescent, subpercurrent to excurrent; upper cells rhomboidal-hexagonal to narrow rhomboid, basal cells quadrate to long-rectangular, cells smooth, thin- or thick-walled. Setae elongate, straight or flexuose. Capsules conic, cylindric, subcylindric, clavate, pyriform, subglobose or ovoid, erect or nodding to usually pendulous, straight or curved, smooth, neck well-developed; opercula conic-apiculate to beaked; annuli large, compound; peristome often complete, exostome teeth 16, narrowly triangular, papillose, endostome slightly papillose, basal membrane usually well-developed, segments keeled, perforate or rudimentary, cilia 2-3, nodose or appendiculate, rudimentary or absent. Spores spherical, smooth or papillose. Calyptra cucullate.

According to Allen (2002), important characters to distinguish *Bryum* are: leaf cell areolation (upper cell length vs. width; thickness of cell walls; basal cell size and shape); costal length; leaf margin posture and border; plant sexuality; leaf base decurrence; capsule shape; and endostome development.

All species show pendulous capsules, except *B. orthodontioides* and *B. limbatum*, which have suberect to horizontal capsules and *B. wrightii*, which has erect capsules. All species have a conic-apiculate operculum, but *B. wrightii*, which has a beaked and high-conic operculum.

Key to the Brazilian species of **Bryum**

1. Capsules erect; peristome reduced; endostome rudimentary; opercula high-conic, beaked; vegetative leaves spatulate ..... 20. *Bryum wrightii*
1'. Capsules pendulous, horizontal to suberect; peristome complete; endostome well-developed; opercula conic-apiculate; vegetative leaves with other shapes 2
2. Plants silvery-green; leaf base green, apex hyaline 3
2'. Plants green, yellowish-green or reddish-green; leaf base and apex green 4
3. Capsules cylindric to conic, neck slender (narrower than the urn); costa weak, evanescent toward the apex, sub-percurrent ..... 5. *Bryum argenteum*
3'. Capsules oblong-cylindric, neck wide (broader than the urn); costa strong, continuous toward the apex, long-excurrent ..... 4. *Bryum arachnoideum*
4. Plants monoicous, synoicous, usually bearing sporophyte 5
4'. Plants usually dioicous, if monoicous and synoicous, rarely bearing sporophyte 6
5. Vegetative leaf margins recurved and bordered by 2-4 rows of narrow, long-rectangular cells ..... 16. *Bryum pallescens*
5'. Vegetative leaf margins plane and not bordered ..... 15. *Bryum pabstianum*
6. Leaves densely congested at the stem apex or congested in rosettes; basal leaf cells porose 7
6'. Leaves evenly spaced along the stem, if congested at the apex of the stem, not forming rosettes; basal leaf cells usually non-porose 8
7. Plants medium- to large-sized (1.5-4 mm high), leaves congested in 1-2 (3) rosettes, margins with teeth occasionally paired, bordered by 1-3 rows of narrow, long-rectangular cells; rhizoidal tubers sometimes present; seta single ..... 7. *Bryum billarderii*
7'. Plants large- to robust-sized (above 3 mm high), leaves congested in 2-4 rosettes, margins with single teeth, distinctly bordered by 3-5 rows of narrow, long-rectangular cells; rhizoidal tubers absent; setae single, rarely doubled ..... 12. *Bryum huillense*

8. Capsule neck smooth or corrugate, short and broader than the urn; leaf margins not bordered, costa excurrent ... 9
8'. Capsule neck smooth, short or elongate and wider than the urn; leaf margins bordered or unbordered, costa sub-percurrent, percurrent to excurrent ... 10
9. Leaf cells thin-walled, basal cells rectangular to sub-quadrate, costa long-excurrent; capsules oblong-cylindric; gemmae or bulbils absent ... 9. *Bryum coronatum*
9'. Leaf cells thick-walled, basal cells sub-quadrate to quadrate, costa short-excurrent; capsules pyriform to ovoid; axillary gemmae and bulbils occasionally present ... 11. *Bryum dichotomum*
10. Vegetative leaves broadly elliptic to ovate, apex obtuse, rarely acute ... 11
10'. Vegetative leaves lanceolate, oblong to obovate, apex acute ... 12
11. Leaf margins bordered by 3-4 rows of narrow, long-rectangular cells, serrulate at apex ... 13. *Bryum limbatum*
11'. Leaf margins not or inconspicuously bordered by 1 row of narrow rectangular cells, entire or denticulate at apex ... 17. *Bryum renauldii*
12. Plants medium- to large-sized (10-70 mm high); bulbils or gemmae absent ... 13
12'. Plants small-sized (up to 10 mm high); bulbils or axillary gemmae sometimes present ... 15
13. Leaf margins not bordered or bordered by 1-2 rows of narrow, long-rectangular cells at base, serrulate at apex, basal cells non-porose, costa weak, evanescent towards the apex, sub-percurrent to percurrent ... 18. *Bryum riparioides*
13'. Leaf margins bordered by 1-5 rows of narrow, long-rectangular cells, serrate, dentate or denticulate at apex, basal cells porose, costa strong, continuous towards the apex, short-excurrent ... 14
14. Vegetative leaves obovate to spatulate, upper cells rhomboidal-hexagonal, margins bordered by 1-3 rows of narrow, long-rectangular cells ... 7. *Bryum billarderii*
14'. Vegetative leaves oblong, lanceolate to elliptic, upper cells narrow rhomboidal-hexagonal to fusiform, margins bordered by 2-5 rows of narrow, long-rectangular cells ... 10. *Bryum densifolium*
15 Leaves spirally-twisted when dry, costa short to long-excurrent, margins not bordered or bordered by 1-4 rows of narrow rectangular cells ... 16
15'. Leaves erect, not spirally-twisted, costa percurrent to short-excurrent, margins not bordered ... 17
16. Leaf upper cells lax, basal cells rectangular, margins bordered by 1-4 rows of narrow rectangular cells ... 8. *Bryum capillare*
16'. Leaf upper cells firm, basal cells distinctly quadrate, margins bordered by 1-2 rows of narrow rectangular cells ... 6. *Bryum atenense*
17. Capsules horizontal to suberect; leaf margins entire, upper cells rhomboidal, lax-walled ... 14. *Bryum orthodontioides*
17'. Capsules pendulous; leaf margins serrulate, upper cells rhomboidal-hexagonal, narrowly hexagonal, narrowly rhomboidal to fusiform, firm-walled ... 18
18. Leaves concave, upper cells elongate and narrowly hexagonal to fusiform, basal cells enlarged, rectangular to quadrate; axillary gemmae sometimes present ... 3. *Bryum apiculatum*
18'. Leaves plane, upper cells narrowly rhomboidal to rhomboidal-hexagonal, basal cells rectangular to sub-quadrate; gemmae absent ... 19. *Bryum subapiculatum*

3. *Bryum apiculatum* Schwägr., Sp. Musc. Frond., Suppl. 1(2): 102. 1816. *Pohlia apiculata* (Schawägr.) Crum & Anders., Mosses E. N. Amer. 1: 534. 1981. Type: Nepal, *Wallich* (*s.n.*) (holotype *acc.* Long (1995) TCD (hb-Harv)); Nepal, *W.H. Harvey* (*s.n.*); (possible isotype E (hb-Menz)).

= *Bryum brachystegium* Müll.Hal. in Paris, Index Bryol. Suppl. 58. 1900, (*nom. nudum*). Original Material: (Brazil) *E. Ule* (*s.n.*) (Bryotheca Brasiliensis 144) (syntypes: BM000873785 image!, BM000873786 image!; H? (hb Broth)), *syn. acc.* Ochi (1974 with *Bryum nitens*).

= *Bryum paulense* Broth., Denkschr. Akad. Wilss. Wien Math. Nat. Kl., 1901: 296. 1924. Type: (Brazil) São Paulo, prope Campo Grande, ad São Paulo Railway, in silvulis campestribus ad terram, *ca.* 700 m.s.m., (s.col.) 566 (syntypes: H (hb Broth.), BM000873773 image!), *syn. acc.* Ochi (1980).

= *Bryum rivulare* Arnold., Revue Bryologique 25: 6. 1898. Type: (Brazil), Rio de Janeiro, *Glaziou 4512* (isotype H), *syn. acc.* Ochi (1974).

= *Bryum naviculare* Hampe, Vid. Medd. Naturh. For. Kjøbenh. 9-10: 260. 1878. Type: Brazil. Rio de Janeiro, *Glaziou 4512* (lectotype BM 000873780! designated by Costa *et al.* (2016); isolectotypes: PC 0135931!; PC 0709468!; PC 0721161!), *syn. acc.* Ochi (1974).

= *Bryum lindmanianum* Broth., Bihang till Kongliga Svenska Vetenskaps-Akademiens Handlingar 26 Afd. 3(7): 30. 1900. Type: Brazil. Rio Grande do Sul, Cachoeira, ad terram, *Lindman 182* (H), *syn. acc.* Ochi (1974).

Fig. 2A-E

Geographic distribution: United States, Mexico, Central America, the Caribbean, western, northern, and southern South America; Europe; Asia; Africa; Australia and the Pacific Islands (Allen 2002; Holyoak 2009); and Brazil (wide

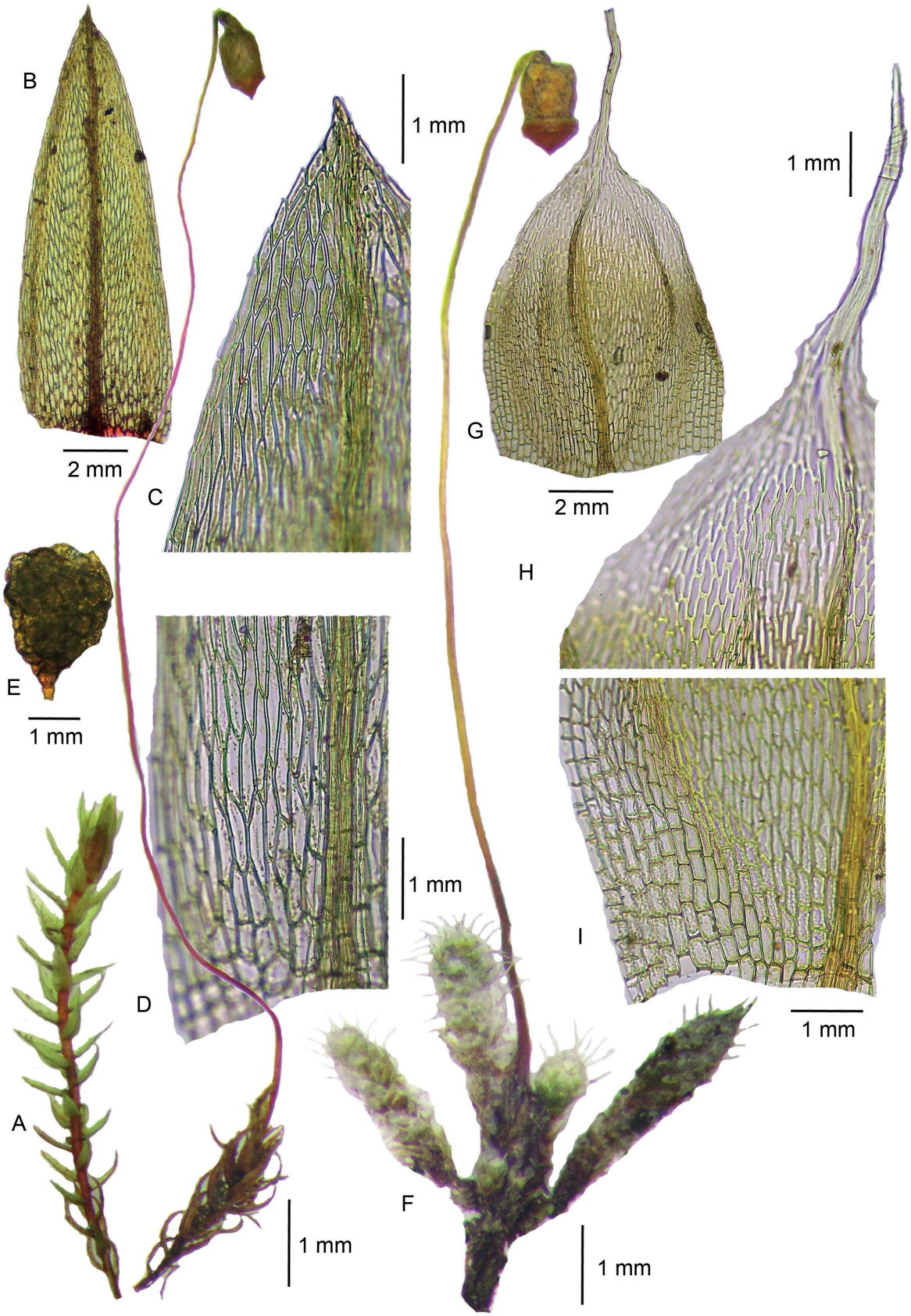

Figure 2. A-E. *Bryum apiculatum* (*D.F. Peralta 13874*, SP). **A**. Habit, wet. **B**. Vegetative leaf. **C**. Vegetative leaf apex. **D**. Vegetative leaf base. **E**. Axillary gemmae. **F-I**. *Bryum arachnoideum* (*D.M. Carmo 1338*, SP). **F**. Habit, wet. **G**. Vegetative leaf. **H**. Vegetative leaf apex. **I**. Vegetative leaf base.

distribution: Amazonas, Bahia, Ceará, Distrito Federal, Espírito Santo*, Goiás, Mato Grosso*, Mato Grosso do Sul*, Minas Gerais, Paraná, Rio de Janeiro, Rio Grande do Sul, Roraima*, and São Paulo). Habitat: on soil, rocks and on wet slopes. It is recorded for the Atlantic Forest, Cerrado and, less commonly, for the Amazon Forest biomes; 50-1500 m.

Plants small, up to 30 mm high, light green, leaves imbricate to lax, erect, evenly spaced. Leaves concave, ovate-lanceolate to lanceolate; apices green, cuspidate; margins not bordered, entire to serrulate, plane; costa strong, percurrent to short-excurrent; upper cells narrowly hexagonal to fusiform, basal cells enlarged, rectangular to quadrate, non-porose, base red, firm- and thin-walled. Axillary gemmae, reddish-brown, globose sometimes present. Dioicous. Capsules green to orange-brown, pendulous, cylindric to conic, neck slender; opercula conic-apiculate; peristome complete; exostome well-developed, endostome with segments well-developed, cilia present.

Selected specimens examined: **BRAZIL. Amazonas:** Manaus, 11/VII/1974, *D. Griffin III 183* (SP); **Bahia:** Camacan, 27/I/1974, *D.M. Vital 2859* (SP); **Ceará:** Caucaia, 6/VIII/2011, *B.E. Chaves 92* (UB); **Distrito Federal:** Brasília, 19/V/1976, *D.M. Vital 6289* (SP); **Espírito Santo:** Fundão, 15/IV/1980, *D.M. Vital 8888* (SP); **Goiás:** Mineiros, 21/V/1976, *D.M. Vital 6376* (SP); Paraúna, 20/V/1976, *D.M. Vital 6328* (SP); **Mato Grosso:** Campinápolis, 19/IV/2009, *A.B. Leal 8* (SP); **Mato Grosso do Sul:** Bonito, 13/VIII/2002, *D.F. Peralta 1876* (SP); **Minas Gerais:** Ouro Preto, 9/II/1976, *D.M. Vital 5536* (SP); Poços de Caldas, 25/XI/2019, *B.K. Canestraro 1575* (SP); **Paraná:** Ipiranga, 15/III/1976, *D.M. Vital 5815* (SP); Quatro Barras, 17/XI/2012, *D.F. Peralta 12776* (SP); **Roraima:** Caracaraí, 28/VII/1974, *D. Griffin III 673* (SP); **São Paulo:** Cubatão, 18/VI/1986, *D.M. Vital 13798* (SP); São José do Barreiro, 17/V/2007, *D.F. Peralta 4985* (SP).

This plant has small-sized (up to 30 mm high), leaves concave, elimbate, with narrowly hexagonal to fusiform upper cells, abruptly larger, and rectangular to quadrate basal cells. Axillary gemmae were observed in a few specimens of *B. apiculatum* (*B.E. Chaves 92* - UB - in the Caatinga; *B.K. Canestraro 1598*, *1646* - SP - in the Atlantic Forest), as reported by Allen (2002) and Ochi (1994).

Bryum apiculatum is similar to *B. orthodontioides* in its small-sized (3 mm high), lanceolate leaves with unbordered margins, acuminate apices, short-excurrent costa, and rectangular basal cells. However, *B. orthodontioides* has even smaller and shorter leaves, entire margins, and upper leaf cells rhomboidal and thin-walled (Fig. 7A-D). *Bryum apiculatum* is also similar to *B. dichotomum* due to its small-sized (1-1.7 mm high) and presence of axillary propagules. However, the latter has leaves with narrowly rhomboidal upper cells, sub-quadrate to quadrate basal cells, thick-walled throughout, and capsules with a broad neck (Fig. 6A-6). *Bryum subapiculatum* differs from *B. apiculatum* in having narrowly rhomboidal to hexagonal-rhomboidal upper cells, rectangular to sub-quadrate basal cells, and the absence of vegetative propagules (Fig. 10A-D).

Bryum apiculatum and *Anomobryum conicum* share their small-sized (15 mm high), imbricate and lanceolate leaves, short-excurrent costa, and unbordered margins. Nevertheless, *A. conicum* has linear and thick-walled upper cells that gradually become narrowly hexagonal to rectangular and sub-quadrate towards the base (vs. the abrupt transition from narrowly hexagonal to fusiform upper cells to enlarged, rectangular to quadrate basal cells in *B. apiculatum*) (Fig. 1A-E). *Brym apiculatum* is similar to *Pohlia elongata* Hedw. due to the aspect of their gametophytes, leaves lanceolate, erect and plane, margins not bordered and serrulate, and percurrent to short-excurrent costa. However, *Pohlia elongata* has paroicous inflorescences, upper cells longer and narrower (4:1 proportion), thick-celled walls, and a more elongate capsule (Allen 2002). *Bryum apiculatum* is similar to *B. nanoapiculatum* Ochi & Kürschner (Ochi & Kürschner 1988). However, the last occurs in Yemen, is smaller in size, has short ovate and mucronate leaves, and short-excurrent costa.

Hodgetts *et al*. (2020) proposed a new combination of *B. apiculatum* to *Anomobryum apiculatum* (Schwägr.) D. Bell & Holyoak. However, the authors based their analysis on few samples from Europe, not taking into account the global distribution of the species. Therefore, we do not follow their classification.

4. *Bryum arachnoideum* Müll.Hal., Flora 62: 378. 1879. Type: Kenya, Orientali-tropica, Kitui in Ukamba, *Hildebrandt s.n.* (holotype B (destroyed according to Frahm (2002), lectotype H (hb. Brotherus) designated by Frahm (2002), isolectotypes: G00051812 image!, PC0136973 image!, PC0136974 image!, JE04003281 image!, JE04003282 image!).

= *Bryum impressotruncatum* Herzog, Arq. Bot. Estado São Paulo 1 (2): 68. 8. 1924. Type: Brazil. Minas Gerais, (Santa Bárbara), *Hoehne 154* (holotype JE; isotypes: SP (ac.088568!), SP (ac.088569!), BM), *syn. acc.* Ochi (1980).

Fig. 2F-I

Geographic distribution: Sub-Saharan Africa and Brazil (rare distribution: Bahia and Minas Gerais; Ochi 1980; O'Shea 2006). Habitat: on rocks. It occurs in the Atlantic Forest, Cerrado, and Caatinga biomes (single record); 700-1400 m.

Plants small, up to 10 mm high, silvery-green. Leaves imbricate, erect, evenly spaced, concave, ovate, oblong to elliptic; apices hyaline, aristate; margins not bordered, entire, plane; costa strong, long-excurrent; upper cells rhomboidal-hexagonal to narrow rhomboidal, basal cells rectangular, sub-quadrate to quadrate, non-porose, firm- and thin-walled. Dioicous. Capsules reddish-brown, pendulous, oblong-cylindric, neck short, corrugate, broader than the urn; opercula conic-apiculate; peristome complete; exostome

well-developed, endostome with segments well-developed, cilia present.

Selected specimens examined: **BRAZIL. Bahia:** Rio de Contas, 27/X/1994, *W.R. Buck 26843* (SP); **Minas Gerais:** Ouro Preto, 22/I/1969, *H.S. Irwin 22452* (SP); São Roque de Minas, 16/VII/2014, *D.M. Carmo 1338* (SP).

It is a species with imbricate leaves with hyaline apices, not bordered margins, long-excurrent costa, and capsules with a broad neck. This species is very similar to *B. argenteum*. However, it has weak, evanescent and sub-percurrent costa, and capsules with a slender neck (Fig. 3A-E). The shape of the capsules and width of the neck is comparable to *B. coronatum*, but it has longer leaves with green apices (Fig. 5A-D). It differs from *B. lanatum* (P. Beauv.) Brid. due to the plants' silvery color, ovate leaves, and excurrent and reflexed costa (the excurrent part ⅓ of the length of the lamina) (Frahm 2002).

5. *Bryum argenteum* Hedw., Sp. Musc. Frond. 181. 1801. Type: " Ad muros, tecta, rupes Europae."

= *Bryum corrugatum* var. *niveum* Hampe, Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn 4: 52. 1872. Type: Brazil. Rio de Janeiro, *Glaziou 5211* (lectotype BM 000960031! designated by Costa *et al*. (2016); isolectotypes: BM 000960030!, BM!, PC 0136603!, PC 0709476!, PC 0721175!), *syn. acc.* Costa *et al*. (2016).

Fig. 3A-E

Geographic distribution: Cosmopolitan (Ochi 1980; Allen 2002), Brazil (wide distribution: Alagoas, Amazonas, Bahia, Espírito Santo, Maranhão, Minas Gerais, Paraíba, Paraná, Pernambuco, Rio de Janeiro, Rio Grande do Sul, Santa Catarina, São Paulo, and Tocantins*). Habitat: on soil, rocks and on artificial substrates. It is recorded in the Atlantic Forest, Cerrado, Caatinga, Pampa, Amazon Forest; 10-2700 m.

Plants small, 3-10 mm high, silvery-green, leaves imbricate, erect, evenly spaced. Leaves concave, oblong-ovate to elliptic; apices hyaline, apiculate; margins not bordered, entire, plane; costa weak, evanescent, sub-percurrent; upper cells rhomboidal to rhomboidal-hexagonal, basal cells rectangular to sub-quadrate, non-porose, firm- and thin-walled. Dioicous. Capsules green to orange-brown, pendulous, cylindric to conic, neck slender; opercula conic-apiculate; peristome complete; exostome well-developed, endostome with segments well-developed, cilia present.

Selected specimens examined: **BRAZIL. Alagoas:** Boca da Mata, 29/X/1980, *D. Andrade-Lima 6655* (SP); **Amazonas:** São Gabriel da Cachoeira, 20/VII/1979, *O. Yano 2089* (SP); **Bahia:** Abaíra, 14/II/1992, *R.M. Harley s.n.* (SP284226); Morro do Chapéu, 3/IV/1976, *D.M. Vital 6042* (SP); **Espírito Santo:** Aracruz, 3/X/1971, *D.M. Vital 1896* (SP); Santa Teresa, 5/VII/1981, *O. Yano 3609* (SP); **Maranhão:** São Luís, 14/V/2005, *M.M.F. Correia s.n.* (SP389641); **Minas Gerais:** Alto Caparaó, 22/IV/2016, *D.F. Peralta 18143* (SP); Itamonte, 1/V/1993, *O. Yano 18970* (SP); **Paraíba:** Esperança, 31/I/1976, *D.M. Vital 5446* (SP); **Paraná:** Campo Mourão, 10/IX/2018, *B.K. Canestraro 1350* (SP); Morretes, 15/VI/2015, *D.F. Peralta 17517* (SP); **Pernambuco:** Garanhuns, 19/I/1972, *D.M. Vital 1970* (SP); São Caetano, 1/XII/2011, *O. Yano 33130* (SP); **Rio de Janeiro:** Angra dos Reis, 21/III/1995, *O. Yano 23730* (SP); Itatiaia, 26/VI/1974, *D.M. Vital 3418* (SP); **Rio Grande do Sul:** Caxias do Sul, 1/I/2006, *J. Bordin 241* (SP); São Gabriel, 22/I/1983, *O. Yano 5806* (SP); **Santa Catarina:** Tubarão, VII/1889, *E. Ule 29* (SP); Urubici, 30/VII/2017, *O. Yano 34257* (SP); **São Paulo:** Campos do Jordão, 24/I/2019, *B.K. Canestraro 1486* (SP); Cunha, 16/III/2018, *D.F. Peralta 23066* (SP); **Tocantins:** Ponte Alta do Tocantins, 5/IX/2018, *O. Yano 34393* (SP).

Bryum argenteum is a weedy species (Allen 2002) that thrives in disturbed environments (Pisa *et al*. 2014). It is characterized by silvery-green gametophytes, leaves elimbate with hyaline apices, costa weak and evanescent, and capsules with a slender neck. *Bryum arachnoideum* is similar to *B. argenteum* due to the color and aspect of the gametophyte, areolation and shape of the leaves. However, that species usually has larger gametophytes and capsules oblong-cylindric with a broad and corrugate neck (Fig. 2F-I). *Bryum argenteum* is similar to *B. lanatum*, but this is a plant hoary white, with stems evenly foliate and inconspicuously julaceous, long-excurrent costa, awns slender and recurved when dry (Spence 2015). *Bryum argenteum* may be similar to *Anomobryum conicum* and *A. julaceum* due to the julaceous stems, imbricate and ovate leaves, and small-sized (10 mm high) (Spence & Ramsay 2002). In contrast, *A. julaceum* has obtuse apices, entire or serrulate margins, and vermicular and thick-walled upper leaf cells (Fig. 1F-I), while *A. conicum* has entire to denticulate margins, strong, percurrent to short-excurrent costa, and linear to narrowly rhomboidal and thick-walled upper cells (Fig. 1A-E). These morphological similarities among *Anomobryum* and *Bryum argenteum* result from convergent evolution since both taxa are molecularly independent (Holyoak & Pedersen 2007; Pedersen *et al*. 2007).

6. *Bryum atenense* R.S. Williams, Bull. New York Bot. Gard. 6(21): 231. 1910. Type: Bolivia. La Paz: Atén, *R. S. Williams 1897* (holotype NY01163274 image!, isotypes: E00348829 image!, BM, H, JE).

Fig. 3F-J

Geographic distribution: Bolivia and Brazil (Ochi 1980; wide distribution: Bahia*, Distrito Federal, Espírito Santo*, Goiás, Maranhão, Mato Grosso, Mato Grosso do Sul, Minas Gerais*, Paraná*, Pernambuco*, Piauí*, Rio Grande do Sul, São Paulo*, and Tocantins). Habitat: on soil, rocks, termite nests, bark or rotting log. It occurs in the Atlantic Forest, Caatinga, Cerrado and Amazon Forest; 5-2000 m.

Plants small- to medium-sized, 3-4 mm high, light green, dark to yellowish-green, leaves imbricate, spirally-twisted when dry, evenly spaced or in inconspicuously rosulate tufts.

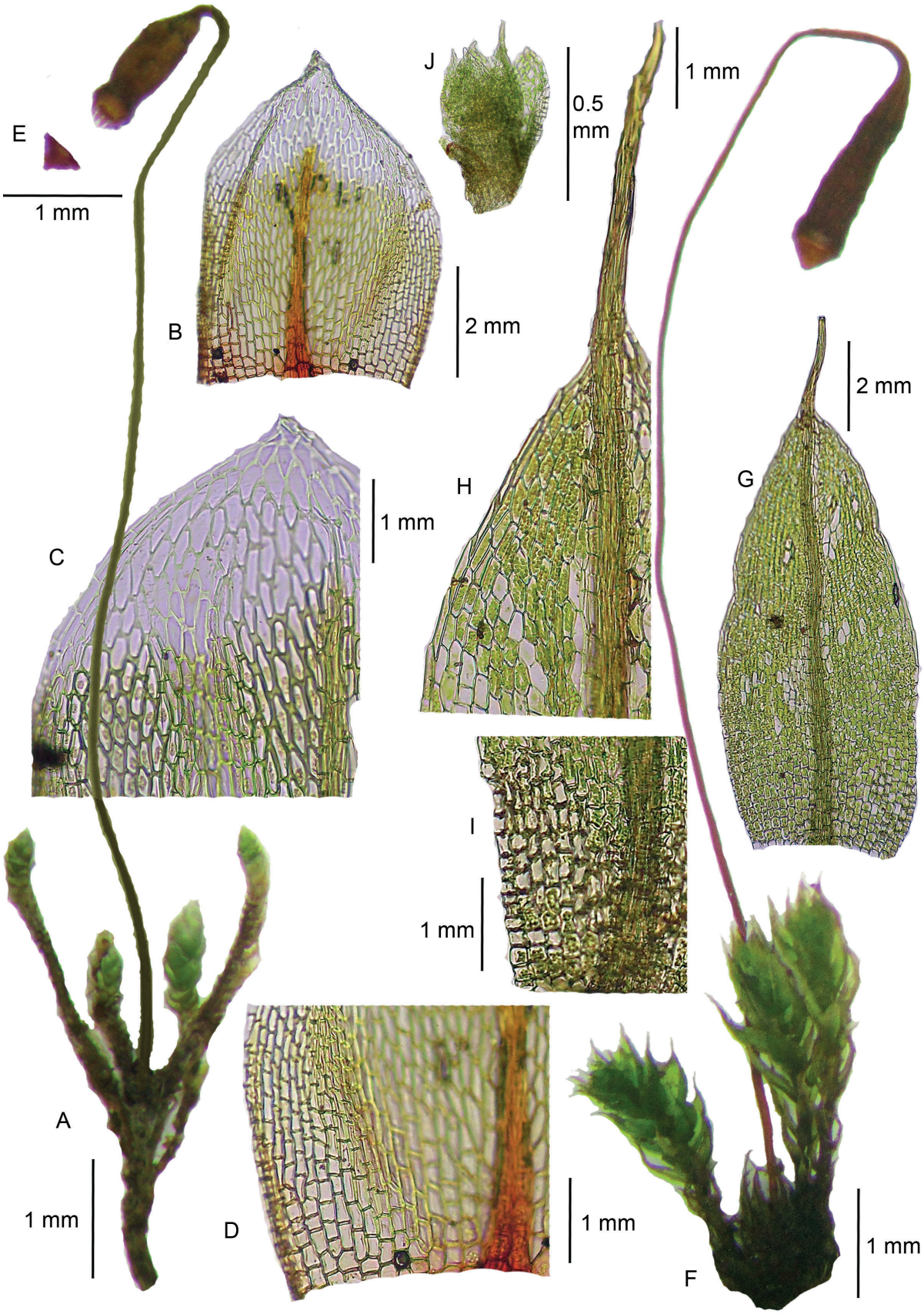

Figure 3. A-E. *Bryum argenteum* (*B.K. Canestraro 1186*, SP). **A**. Habit, wet. **B**. Vegetative leaf. **C**. Vegetative leaf apex. **D**. Vegetative leaf base. **E**. Operculum. **F-J**. *Bryum atenense* (F-I. *D.F. Peralta 20533*, SP; *J. O. Yano 33878*, SP). **F**. Habit, wet. **G**. Vegetative leaf. **H**. Vegetative leaf apex. **I**. Vegetative leaf base. **J**. Axillary bulbil.

Leaves elliptic, lanceolate to ovate-lanceolate; apices green, aristate; margins not bordered or bordered by 1-2 rows of narrow, long rectangular cells, entire or serrulate in the upper half, plane or recurved at base; costa strong, short to long-excurrent; upper cells rhomboidal-hexagonal, basal cells distinctly quadrate, non-porose, thin- and firm-walled. Axillary bulbils sometimes present. Dioicous. Capsules green to orange-brown, pendulous, cylindric to conic, neck slender; opercula conic-apiculate; peristome complete; exostome well-developed, endostome with segments well-developed, cilia present.

Selected specimens examined: **BRAZIL. Bahia:** Caetité, 13/V/1978, *D.M. Vital 7955* (SP); Correntina, 28/I/1967, *D.M. Vital 1110* (SP); **Distrito Federal:** Brasília, 2/V/.2009, *P.E.A.S. Câmara 1808* (UB); **Espírito Santo:** Guarapari, 1/V/1991, *D.M. Vital s.n.* (SP387377); Vitória, w.d., *N.Y. Tomita s.n.* (SP223199); **Goiás:** Alto Paraíso de Goiás, 27/I/1991, *O. Yano 15168* (SP); Formoso, 2/IX/1979, *D.M. Vital 8540* (SP); **Maranhão:** Caxias, 17/III/2017, *L.A. Amélio 256* (SP); **Mato Grosso:** Chapada dos Guimarães, 14/VII/2018, *B.K. Canestraro 1246* (SP); Sinop, 7/III/2008, *F.R. Borges 95* (SP); **Mato Grosso do Sul:** Rio Brilhante, 26/V/1976, *D.M. Vital 6475* (SP); **Minas Gerais:** Alagoa, 28/I/2019, *B.K. Canestraro 1533* (SP); Belo Horizonte, 22/X/1996, *O. Yano 24793* (SP); **Paraná:** Jaguariaíva, 30/IV/2011, *R. Ristow 1389* (SP); Tibagi, 6/VII/2013, *E.D. Lozano 1290* (SP); **Pernambuco:** São Caetano, 1/XII/2011, *O. Yano 33121* (SP); Triunfo, 7/IX/1980, *O. Yano 2976* (SP); **Piauí:** Oeiras, 6/II/1974, *D.M. Vital 2934* (SP); **Rio Grande do Sul:** Torres, 9/I/2019, *T.S. Dewes s.n.* (HERW2158); **São Paulo:** Bauru, 3/VI/2008, *J. Bordin 780* (SP); Ibiuna, 28/VII/1989, *O. Yano 13287* (SP); **Tocantins:** Ponte Alta do Tocantins, 4/IX/2018, *O. Yano 34374* (SP).

Bryum atenense is characterized by imbricate leaves that become spirally-twisted when dry, long-excurrent costa, leaf basal cells distinctly quadrate, and axillary bulbils sometimes present. This species resembles *B. capillare* due to the leaves that become spirally-twisted when dry, the presence of bulbils, and excurrent costa. However, the latter has leaves with rectangular basal cells and bordered margins with 1-4 rows of narrow, rectangular cells (Fig. 4E-I). Furthermore, *B. capillare* occurs mostly in mountain regions of Southern and Southeastern Brazil, while *B. atenense* is widespread in Brazil. *Bryum caespiticium* Hedw. differs from *B. atenense* by the closely imbricate and concave leaves, conspicuous awns, and inflated subulate cells on fertile stems (Ochi 1980; Spence 2015). *Bryum atenense* is similar to *Brachymenium exile* (Dozy & Molk.) Bosch & Sande Lac. due to the short-excurrent costa, ovate leaves with quadrate basal cells, and the presence of gemmae. However, *B. exile* has erect-appressed to imbricate leaves, erect capsules, and rudimentary endostome (Allen 2002). In addition, *B. exile* represents a doubtful record for Brazil (Canestraro & Peralta unpubl. res.).

During the analysis of the SP collection, it was verified that several samples identified as *Bryum capillare*, *Brachymenium exile* and *Brachymenium coarctatum* were misidentifications of *Bryum atenense*.

7. *Bryum billarderii* Schwägr., Sp. Musc. Frond. Suppl. 1(2): 115. 1816. *Rosulabryum billarderii* (Schwägr.) Spence, Bryologist 99: 223. 1996. Type: (Australia?). "Legit in Novo Belgio *Billardiere*, australium terrarum investigator celeberrimus."

= *Rhodobryum horizontale* Hampe, Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn ser. 3, 6: 148. 1874. Type: Brazil: Rio de Janeiro, Morro Queimado, *Glaziou 7164a* (lectotype BM000873677!); isolectotype: (PC0709457!), *syn. acc.* Canestraro & Peralta (in press).

= *Rhodobryum stenothecium* Hampe, Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn, ser. 3, 6: 147. 1875. *Bryum stenothecium* (Hampe) Hampe, Ibid. ser. 4, 1: 103. 1879. Type: Brazil. Rio de Janeiro, *Glaziou 6362* (lectotype BM000873751 image! designated by Costa *et al.* (2016); isolectotypes: BM000873752 image!, PC0136237 image!, PC0709459 image!, PC0721108 image!), *syn. acc.* Ochi (1980).

= *Bryum brasiliense* Hampe, Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn, ser. 3, 10: 261. 1878. Type: Brazil. Rio de Janeiro, *Glaziou 7934* (lectotype BM000873705 image! designated by Costa *et al.* (2016); isolectotypes: BM000873706 image!, BM000873707 image!, BM000873708 image!, BM000873709 image!, PC0136482 image!, PC0136483 image!, PC0709479 image!, PC0721111 image!, PC0721125 image!), *syn. nov.*

= *Bryum patens* Hook. f. & Wilson, London Journal of Botany 3: 155. 1844. *nom. nud.*, latter homonym, non Dicks. Ex With., 1801. Original Material: (Brazil. Ceará) rocks, Serra do Araripe, oct.1838, *Gardner* (*s.n.*) (NY?), *syn. acc.* Ochi (1980).

Fig. 4A-D

Geographic distribution: United States, Mexico, Central America, the Caribbean, western, northern, and southern South America; Africa; Subantarctic Islands; Asia; Oceania (Allen 2002); and Brazil (moderate distribution: Bahia, Goiás, Mato Grosso, Minas Gerais, Paraná, Pernambuco, Rio de Janeiro and São Paulo); Ochi (1980) cited for Santa Catarina. Habitat: on soil, rock and occasionally over barks. The species occur in the Atlantic Forest, Cerrado and Caatinga biomes; 20-2600 m.

Plants medium- to large-sized, 15-25 (50) mm high, dark green to yellowish-green, leaves imbricate, spirally-twisted and crisped when dry, evenly spaced with leaves congested at apex or in dense rosulate tufts, 1-2 (3) congested rosettes. Leaves obovate to spatulate; apices green, cuspidate; margins distinctly bordered by 1-3 rows of narrow, rectangular cells, serrate to denticulate in the upper half, teeth occasionally paired, recurved at base; costa strong, short-excurrent; upper cells rhomboidal-hexagonal, basal cells rectangular, porose,

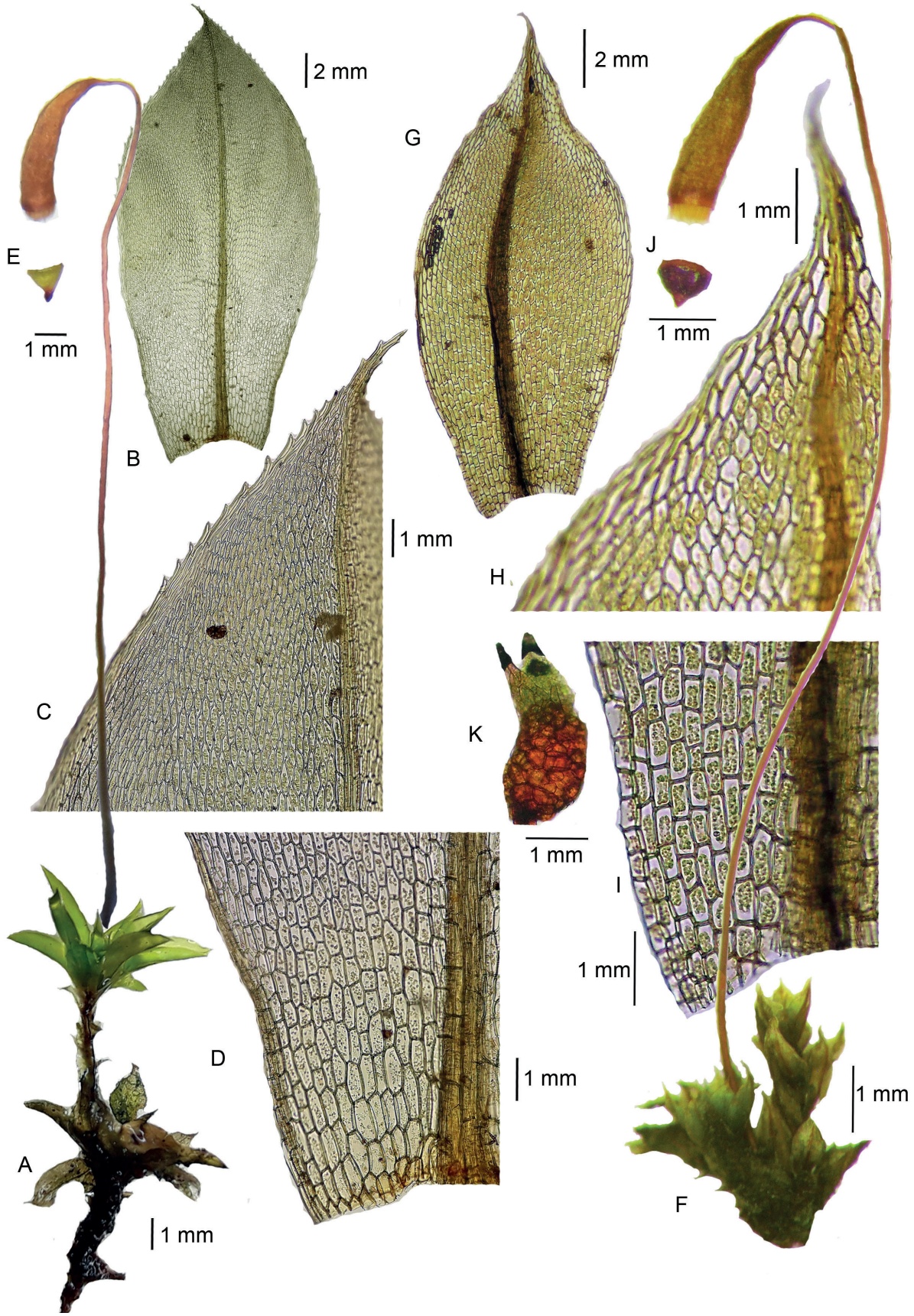

Figure 4. A-E. ***Bryum billarderii*** (*B.K. Canestraro 1536*, SP). **A**. Habit, wet. **B**. Vegetative leaf. **C**. Vegetative leaf apex. **D**. Vegetative leaf base. **E**. Operculum. **F-J**. *Bryum capillare* (*B.K. Canestraro 1040*, SP). **F**. Habit, wet. **G**. Vegetative leaf. **H**. Vegetative leaf apex. **I**. Vegetative leaf base. **J**. Operculum. **K**. Axillary gemmae.

firm- and thin-walled. Rhizoidal tubers sometimes present. Dioicous. Capsules green to orange-brown, pendulous to horizontal, cylindric to conic, neck slender; opercula conic-apiculate; peristome complete; exostome well-developed, endostome with segments well-developed, cilia present.

Selected specimens examined: **BRAZIL. Bahia:** Boa Nova, 27/VI/2013, *A.M. Souza 766* (SP); Serra Preta, 2/IV/1976, *D.M. Vital 5995* (SP); **Goiás:** Formosa, 28/XI/1985, *D.M. Vital 13464* (SP); Pirenópolis, 18/III/2006, *O. Yano 28746* (SP); **Mato Grosso:** Chapada dos Guimarães, 5/VII/1987, *A. Schäfer-Verwimp 6822* (SP); **Minas Gerais:** Alagoa, 28/I/2019, *B.K. Canestraro 1534* (SP); Itamonte, 10/VI/2015, *D.F. Peralta 17322* (SP); **Paraná:** Morretes, 20/IV/2015, *D.F. Peralta 16811* (SP); Quatro Barras, 26/XI/2020, *B.K. Canestraro 1621* (SP); **Pernambuco:** Jaqueira, 1/VI/2001, *M.R. Pietrobom-Silva 5296* (SP); **Rio de Janeiro:** Angra dos Reis, 22/III/1995, *O. Yano 23812* (SP); Itatiaia, 26/VI/1974, *D.M. Vital 3403* (SP); **São Paulo:** Bertioga, 7/VIII/1988, *D.M. Vital 16245* (SP); Campos do Jordão, 26/I/2019, *B.K. Canestraro 1523* (SP).

This is a medium- to large-sized plant (15-25 (50) mm high), with leaves evenly spaced and congested at the apex or in dense 1-2 (3) rosulate tufts, obovate, distinctly bordered margins serrate above, and short-excurrent costa. Sterile plants usually have evenly spaced leaves, which are smaller and scattered below and larger and congested above, not distinctly rosulate (Ochi 1994). The species is extremely variable in stature, leaf size and arrangement, border width, costa excurrence, and presence of axillary filaments (Ochi 1994; Allen 2002). Axillary filaments were not observed in the studied Brazilian samples. The presence of rhizoidal tubers is rare among Brazilian specimens (*i.e.*, *Peralta 4056* - SP385870).

This species is close to *B. huillense* in its large-sized, rosulate gametophytes, obovate leaves, with margins bordered and serrate above. However, *B. huillense* is large to robust in size (10-40 (60) mm high), with up to 4 rosettes, leaves larger and bordered by 3-5 rows of narrow rectangular cells, and polysety (rarely) compared with *B. billarderii* (Fig. 6F-J). *Bryum billarderii* shows gametophytes with whorled leaves, leaf areolation, and shape and margins, which are similar to *Brachymenium consimile* (Mitt.) A. Jaeger and *B. radiculosum* (Schwägr.) Hampe. Nevertheless, in these species, the leaves are arranged in one inconspicuous whorl, erect capsules, and rudimentary endostome (Canestraro & Peralta unpubl. res.). The rosulate and obovate leaves of *B. viridescens* Welw. & Duby are reminiscent of *B. billarderii*. However, the first has unbordered leaves and occurs in South Africa, Angola (Magill 1987), and Chile (Ochi 1977).

The type material of *Rhodobryum stenothecium* and *Bryum liebmannii* Schimp. (synonym of *B. billarderii* acc. Allen, 2002 - BM000873712 image!, BM000873738 image!) were analyzed. The gametophytes show variable morphology, with leaves evenly spaced and congested at the apex or in up to 3 dense leaf whorls.

Bryum andicola Hook. was recorded for Brazil (Costa & Peralta 2015). However, this name is a synonym of *B. billarderii* (Ochi 1980; Allen 2002)

8. *Bryum capillare* Hedw., Sp. Musc. Frond. 182. 1801. *Rosulabryum capillare* (Hedw.) Spence, Bryologist 99: 223. 1996. *Ptychostomum capillare* (Hedw.) Holyoak & N. Pedersen, J. Bryol. 29: 119. 2007. Type: Europe.

= *Bryum cavum* Müll.Hal., Bot. Zeit. (Berlin) 2: 727. 1844. Type: Brazil. (Arrayal), *Gardner 36b* (holotype BM, possible isotype NY01168881 image!), *syn. acc.* Ochi (1980).

= *Bryum abbreviatum* Hampe, Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn, ser. 4, 1: 103. 1879. Type: Brazil. Rio de Janeiro, *Glaziou 9212* (lectotype BM000873719! designated by Costa *et al*. (2016); isolectotypes: BM000873720! PC0137047 image!, PC0709454 image!, PC0721974 image!, H), *syn. acc.* Ochi (1980).

= *Bryum itatiayae* Broth, Ergebn. Bot. Exp. Südbras., Musci 297. 1924. Type: Brazil. Minas Gerais/Rio de Janeiro, Schiffner 420 (holotype H; isotype BM000960029!), *syn. acc.* Ochi (1980).

Fig. 4E-I

Geographic distribution: Subarctic America, North, Central and South America; Subantarctic Islands; Europe; Asia; Africa; Oceania (Allen 2002); and Brazil (moderate distribution: Goiás, Mato Grosso, Maranhão*, Minas Gerais, Paraná*, Rio de Janeiro, Santa Catarina, and São Paulo). Habitat: on rock, soil and rotting wood. It is recorded for the Atlantic Forest and Cerrado biomes in high altitudes from 900-2400 m.

Plants small- to medium-sized, 5-50 mm high, light green to reddish-green, leaves lax or imbricate, spirally-twisted when dry, evenly spaced or in inconspicuously rosulate tufts. Leaves obovate to elliptic; apices green, cuspidate; margins distinctly bordered by 1-4 rows of narrow, rectangular cells, serrulate, plane or recurved; costa strong, short- to medium-excurrent, red; upper cells hexagonal, lax-walled, basal cells rectangular, non-porose, thin- and firm-walled. Axillary gemmae and bulbils occasionally present. Dioicous. Capsules green to orange-brown, pendulous, cylindric to conic, neck slender; opercula conic-apiculate; peristome complete; exostome well-developed, endostome with segments well-developed, cilia present.

Selected specimens examined: **BRAZIL. Goiás:** Alto Paraíso de Goiás, 12/II/2011, *D.F. Peralta 12037* (SP); **Maranhão:** Caxias, 18/VI/2014, *G.M. Conceição 70* (SP); **Mato Grosso:** Nova Xavantina, 23/X/2006, *M. Passarelli 58* (SP); **Minas Gerais:** Alto Caparaó, 8/VII/2009, *J. Bordin 1528* (SP); Itamonte, 8/VI/2015, *D.F. Peralta 16824* (SP); **Paraná:** Piraquara, 17/V/2021, *B.K. Canestraro 1774* (SP); **Rio de Janeiro:** Itatiaia, 5/VII/1991, *D.M. Vital s.n.* (SP387519); Teresópolis, 21/III/2017, *D.F. Peralta 20465* (SP); **Santa Catarina:** Tubarão, 1889, *E. Ule 28* (SP); **São**

Paulo: Cabreúva, 5/VIII/1997, *O. Yano 24860* (SP); São Bento do Sapucaí, 11/X/2009, *D.F. Peralta 10145* (SP).

Bryum capillare has leaves spirally-twisted when dry, bordered margins, costa short- to medium-excurrent, lax upper cell walls, and axillary gemmae and bulbils are occasionally present. This species occurs in the mountain regions of Southern and Southeastern Brazil, especially in the Serra da Mantiqueira and Serra do Mar ranges. This species is very polymorphic (Casas *et al*. 2006), with the cell row number in the margins varying from 1-2 (Ochi 1967) to 3-7 rows of thick-walled cells (Allen 2002), depending on its geographic location.

The species resembles *B. atenense* due to the long-excurrent costa and spirally-twisted leaves, but it has leaves with quadrate basal cells and bordered margins by 1-2 narrow rectangular cells (Fig. 3F-J). *Bryum capillare* differs from *B. pallescens* because the latter is synoicous, and the leaf has thick cells at the base, and recurved margins (Fig. 8E-H). *Bryum capillare* is similar to *B. pseudocapillare* Besch. However, this species has filiform axillary gemmae, percurrent to short-excurrent costa and leaves not conspicuously spirally-twisted (Ochi 1980; Allen 2002). The features leaf areolation (hexagonal upper cells and rectangular basal cells) and gametophyte aspect (leaves lax, spirally-twisted, and in inconspicuously rosulate tufts) of *Bryum capillare* could be confused with *Brachymenium consimile* and *B. radiculosum*. However, both species of *Brachymenium* have spatulate leaves, erect capsules, and rudimentary endostome (Canestraro & Peralta unpubl. res.).

The analysis of the illustration and the type image of *Bryum caespiticium* var. laxum Hook. f. & Wilson (*Gardner 36a* - NY01168795 image!) suggests that this species might be a synonym of *Bryum capillare*.

9. *Bryum coronatum* Schwägr., Sp. Musc. Frond. Suppl. 1(2): 103. 1816. *Gemmabryum coronatum* (Schwägr.) J.R. Spence & H.P. Ramsay, Phytologia 87(2): 66. 2005. Type: French Guiana, *Richard 43* (lectotype S-PA, designated by Ochi 1890), possible isolectotype PC0136548 image!).

= *Bryum barbulaceum* Müll.Hal., Linnaea 39: 389. 1875. Type: Brazil. (Rio de Janeiro), Organ Mountains, Gardner 35 p.p. (NY, H?), *syn. acc.* Wijk *et al.* (1959).

Fig. 5A-D

Geographic distribution: United States, Mexico, Central America, Caribbean, western, northern, and southern South America; Africa; Subantarctic Islands; Asia; Africa; Oceania, Pacific Islands (Allen 2002) and Brazil (wide distribution: Acre, Bahia, Ceará, Distrito Federal, Espírito Santo*, Goiás, Maranhão, Mato Grosso, Minas Gerais, Paraná, Pernambuco, Piauí, Rondônia, Rio de Janeiro, Rio Grande do Sul, Roraima, São Paulo, Sergipe, and Tocantins). Habitat: on soil, rock, bark, rotting log, burned wood and cement walls. It is widely distributed in the biomes Atlantic Forest, Cerrado, Amazon Forest, Caatinga, Pantanal and Pampa (rarely); 10-1200 m.

Plants medium-sized, up to 20 mm high, light green, leaves lax or imbricate, erect, evenly spaced. Leaves ovate to ovate-lanceolate; apices green, aristate; margins not bordered, entire to serrulate at apex, plane or recurved at base; costa long-excurrent; upper cells hexagonal, basal cells rectangular to sub-quadrate, non-porose, firm- and thin-walled. Dioicous. Capsules reddish-brown, pendulous, oblong-cylindric, usually red, neck short, corrugate and broader than the urn; opercula conic-apiculate; peristome complete; exostome well-developed, endostome with segments well-developed, cilia present.

Selected specimens examined: **BRAZIL. Acre:** Rio Branco, 28/V/1987, *D.M. Vital 14926* (SP); **Bahia:** Santa Brígida, 24/V/1978, *D.M. Vital 8177* (SP); Morro do Chapéu, 17/V/1978, *D.M. Vital 8177* (SP); **Ceará:** Ubajara, 11/VI/2008, *O. Yano 31259* (SP); **Distrito Federal:** Brasília, 9/IV/1976, *D.M. Vital 6117* (SP); **Espírito Santo:** Santa Cruz, 4/VII/1981, *O. Yano 3585* (SP); **Goiás:** Alto Paraíso de Goiás, 13/II/2011, *D.F. Peralta 12250* (SP); Cristalina, 4/II/1987, *J.R. Pirani 1575* (SP); **Maranhão:** Carolina, 22/III/2017, *L.A. Amélio 337* (SP); Caxias, 31/V/2007, *E.S. Brito 238* (SP); **Mato Grosso:** Aripuanã, 9/X/1996, *P.G. Windisch 8550* (SP); Barra do Garça, 20/V/1968, *D.M. Vital 1344* (SP); **Minas Gerais:** Lagoa Santa, 17/IX/1985, *D.M. Vital 11859* (SP); **Paraíba:** João Pessoa, 23/VII/2001, *D.F. Peralta 1345* (SP); **Paraná:** Candói, 16/I/2018, *B.K. Canestraro 1188* (SP); **Pernambuco:** Recife, 1/II/1976, *D.M. Vital 5448* (SP); **Piauí:** Bom Jesus, 27/V/1978, *D.M. Vital 8224* (SP); Canto do Buriti, 26/V/1978, *D.M. Vital 8206* (SP); **Rio Grande do Sul:** Santana do Livramento, 6/IV/2017, *F. Gonzatti 3612* (SP); **Rondônia:** Jaru, 17/X/1986, *D.M. Vital 14555* (SP); **Roraima:** Amajari, 7/IX/2017, *D.F. Peralta 21494* (SP); Caracaraí, 2/VIII/1974, *D. Griffin III 604* (SP); **São Paulo:** Cananéia, 24/III/1983, *D.M. Vital 10944* (SP); Mogi Guaçu, 29/VI/2017, *D.F. Peralta 20668* (SP); **Sergipe:** São Cristóvão, 22/I/1992, *O. Yano 16480* (SP); **Tocantins:** Araguaína, 20/II/2014, *R. Santos-Silva 1027* (SP).

Bryum coronatum is characterized by the ovate to ovate-lanceolate leaves with unbordered margins and long-excurrent costa and oblong-cylindric capsules with a corrugate and broad neck. Ochi (1980) mentions that this species presents axillary gemmae. However, this feature was not observed in the Brazilian specimens. The gametophyte aspect, leaf shape, excurrence of the costa and shape of the basal cells are plastic features (Ochi 1980), probably due to the wide distribution of the species.

This species is similar to *B. subapiculatum* in aspect to leaf shape and areolation. However, the latter has cylindric to conic capsules and a slender neck (Fig. 10A-D). *Bryum coronatum* and *B. arachnoideum* share the oblong-cylindric capsules with a corrugated and broad neck, but this species is silvery-green with leaves imbricated with hyaline apices (Fig. 2F-I). *Bryum dichotomum* also has capsules with a broad neck. However, it has thick cell walls, pyriform to ovoid capsules, and sometimes vegetative propagules (Fig. 6A-E).

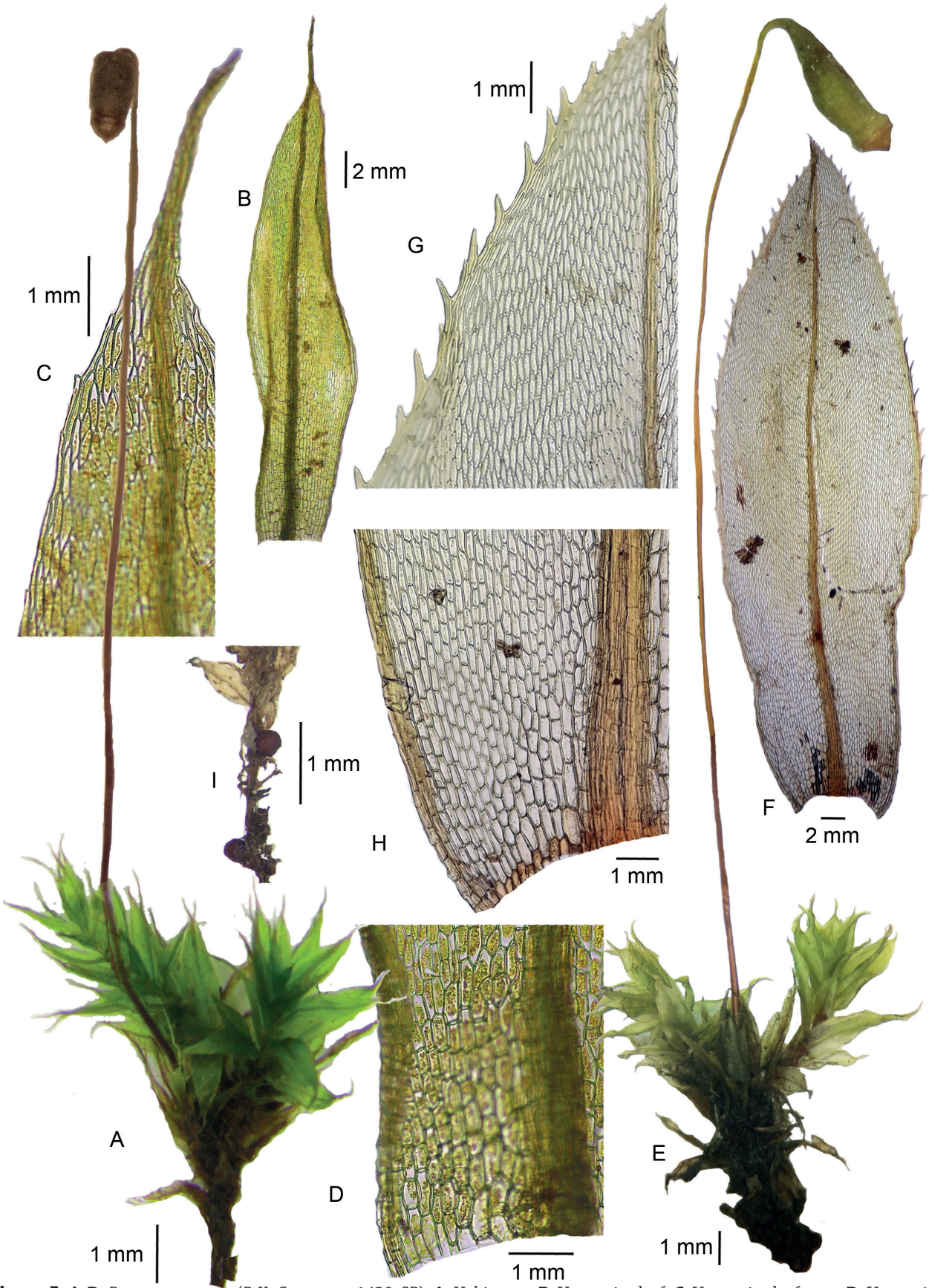

Figure 5. A-D. *Bryum coronatum* (*B.K. Canestraro 1430*, SP). **A**. Habit, wet. **B**. Vegetative leaf. **C**. Vegetative leaf apex. **D**. Vegetative leaf base. **E-I**. *Bryum densifolium* (*B.K. Canestraro 1080*, SP). **E**. Habit, wet. **F**. Vegetative leaf. **G**. Vegetative leaf apex. **H**. Vegetative leaf base. **I**. Rhizoidal tubers.

10. *Bryum densifolium* Brid., Bryol. Univ. 1: 855. 1827. *Rosulabryum densifolium* (Brid.) Ochyra, Biodivers. Poland 3: 162. 2003. Type: South Americ*a*. "Inter muscos Americanos in Andibus lectos neglectam sterilemque invenimus."

= *Bryum aberrans* Hampe in Vidensk. Meddel. Naturhist. Foren. Kjøbenhavn, ser. 3, 10: 260. 1878. Brazil. Rio de Janeiro, *Glaziou 7440* (lectotype BM000960023 image! designated by Costa *et al*. (2016); isolectotypes: BM000960022 image!, PC0137046 image!), *syn. acc.* Ochi (1980).

= *Bryum catharinae* Müll.Hal. in Paris, Ind. Bryol. Suppl. 60. 1900, *nom. nud*. Original Material: (Brazil) *E. Ule s.n.* (Bryotheca Brasilensis 140) (H?, isotype BM), *syn. acc.* Ochi (1980, in the examined material).

= *Bryum validius* Hampe in Vidensk. Meddel. Naturhist. Foren. Kjøbenhavn, ser. 4, 1: 104. 1879. Brazil. Rio de Janeiro, *Glaziou 5139* (lectotype BM000873742 image! designated by Costa *et al*. (2016); isolectotypes: BM000873741 image!, PC0721139 image!), *syn. acc.* Ochi (1980).

= *Bryum pseudomarginatum* Geh. et Hampe, Flora 64: 375. 1881. Type: Brazil. São Paulo: (Apiaí), *Puiggari 1829* (holotype BM000873766 image!, isotypes: G00280024 image!, PC0721140 image!), *syn. nov.*

= *Bryum gracilescens* Müll.Hal. var. *duplicatum* Ren. et Card., Bull. Soc. Roy. Bot. Belg. 34(2): 62. 1896. Lectotype (designated by Ochi 1980): Type: Brazil. São Paulo. (São Vicente close to Santos), *Horeau s.n.* (PC0136667 image!; isolectotypes: PC0136666 image!, PC0136668 image!, PC0136669 image!), *syn. acc.* Ochi (1980).

Fig. 5E-I

Geographic distribution: Mexico, Central America, Caribbean, western, northern, and southern South America; Australia (Allen, 2002); and Brazil (wide distribution: Bahia, Espírito Santo, Minas Gerais, Paraná, Pernambuco, Rio de Janeiro, Rio Grande do Sul, Santa Catarina, São Paulo, and Sergipe*). Habitat: on soil (including sandy soil), rock, base of tree trunks, and boulders. It is recorded for the Atlantic Forest, Pampa, Caatinga, and Amazon Forest (rarely) biomes; 10-1200 m.

Plants large-sized to robust, 20-70 mm high, light green to yellowish-green, leaves lax, flexuose and contorted when dry, evenly spaced. Leaves oblong, lanceolate to elliptic; apices green, mucronate; margins bordered by 2-5 rows of narrow, linear cells, sharply serrate in the upper half, teeth sometimes paired, plane or recurved at base; costa strong, short-excurrent; upper cells narrow rhomboidal-hexagonal to fusiform, basal cells rectangular, porose, firm- and thin-walled. Rhizoidal tubers sometimes present. Dioicous. Capsules green to orange-brown, pendulous to horizontal, cylindric to conic, neck slender; opercula conic-apiculate; peristome complete; exostome well-developed, endostome with segments well-developed, cilia present.

Selected specimens examined: **BRAZIL. Bahia:** Cravolândia, 19/XII/1991, *E. Fontes s.n.* (SP241988); Morro do Chapéu, 3/IV/1976, *D.M. Vital 6024* (SP); **Espírito Santo:** Santa Teresa, 5/VII/1981, *O. Yano 3612* (SP); Vítor Hugo, 25/VII/1987, *A. Schäfer-Verwimp 8868* (SP); **Minas Gerais:** Alto Caparaó, 31/X/1994, *W.R. Buck 27002* (SP); Miraí, 11/III/2018, *D.F. Peralta 22580* (SP); **Paraná:** Balsa Nova, 23/VI/2012, *W.T. Ferreira 23* (SP); Morretes, 4/I/2018, *B.K. Canestraro 1162* (SP); **Pernambuco:** Quipapá, 2/IX/1980, *O. Yano 2867* (SP); **Rio de Janeiro:** Resende, 21/VI/1983, *O. Yano 7526* (SP); **Rio Grande do Sul:** Caxias do Sul, 26/I/2006, *J. Bordin 338* (SP); Santana do Livramento, 2/IX/2017, *D.F. Peralta 21221* (SP); **Santa Catarina:** Botuverá, 25/VII/1966, *P.R. Reitz 17999* (SP); Imbituva, 18/XI/1979, *O. Yano 2229* (SP); **São Paulo:** Cananéia, 23/V/1974, *D.M. Vital 3165* (SP); Mogi das Cruzes, 15/VI/2007, *D.F. Peralta 5156* (SP); Sergipe: Cristinápolis, 27/I/1974, *D.M. Vital 2864* (SP); Itabaiana, 29/I/1974, *D.M. Vital 2872* (SP).

Bryum densifolium is a robust plant (20-70 mm high), with leaves evenly spaced along the stem, which have a distinct sharply serrate border in the upper half and are often reflexed in the lower half, upper cells narrow rhomboidal-hexagonal, and basal cells rectangular and porose. *Bryum densifolium* is variable in plant size and leaf shape, size, and leaf arrangement (Ochi 1967). The size (15-25 mm high) and leaf arrangement are similar to *Bryum billarderii*. However, the latter has leaves varying from evenly spaced to rosulate (up to 3 rosettes), with obovate to spatulate leaves (Fig. 4A-D). *Bryum procerum* Schimp. ex Besch. can be distinguished from *B. densifolium* in its broader, long-decurrent and conspicuously limbate leaves, inconspicuous or absent dorsal stereids and generally plurisetous condition (Allen 2002).

According to Ochi (1980), *B. pseudomarginatum* Geh. & Hampe can be distinguished by the leaves conspicuously crisped when dry, denticulate at the apex, and teeth irregular in size, shape and arrangement. Alternatively, *B. densifolium* has leaves wrinkled or flexuose and spreading when dry, serrate at the apex, and teeth regular in shape and size. However, the type of *B. pseudomarginatum* (*Puiggari 1829* - BM, G, PC) has flexuose and spreading leaves, which is a character of *B. densifolium*. Furthermore, *B. densifolium* and *B. pseudomarginatum* show variable leaf upper cell shape, and the rows of elongate cells at the margin can vary from 1-2 up to 3-5. Thus, we believe the characters used by Ochi (1980) to separate the species are not supported. Since we have analyzed images of both type specimens and a vast collection from Brazil (including a specimen seen and identified by Ochi (1980) as *B. pseudomarginatum* - Vital 2201 - SP90473!), we synonymize *B. pseudomarginatum* under *B. densifolium*.

11. *Bryum dichotomum* Hedw., Spec. Musc. Frond. 183. pl. 42, f. 8–12. 1801. *Mnium dichotomum* (Hedw.) P. Beauv., Prod. Aethéogam: 74. 1805. Type: (New Zealand), *s. coll.* (lectotype G00040365 image! (hb Hedwig/Schwägrichen) designated by Ochyra *et al*. (2008)).

= *Bryum angusticymba* Müll.Hal., Gen. Musc. Frond. 208. 1901, *nom. nudum*. Original Material: (Brazil. Santa Catharina) *E. Ule* (*944*) (PC, H?), *syn. acc.* Ochi (1980, in the examined material).

= *Bryum bulbillosum* Mont., Ann. Sc. Nat., Bot., ser. 2, 16: 268. 1841. Type: Brazil. Rio de Janeiro, *Riedel s.n.* (possible holotype PC, isotypes: G00047786 image!, G00047787 image!, G00047788 image!), *syn. acc.* Ochi (1980).

= *Bryum ferriviae* Mül. Hal., Index Bryol. Suppl. Primum 63. 1900. *nom. nudum*. Type: Brazil. Santa Catarina, Tubarão, *Ule 139* (syntypes: BM000873695 image!, G00051942 image!, NY01169049 image!, PC0136625 image!, JE), *syn. acc.* Ochi (1980, in the examined material).

Fig. 6A-E

Geographic distribution: subcosmopolitan (Allen 2002); in Brazil (moderate distribution: Bahia*, Minas Gerais*, Paraná*, Pernambuco*, Rio de Janeiro, Rio Grande do Sul*, Santa Catarina, and São Paulo). Without record for Brazil according to the Brazilian checklists (Costa *et al*. 2011; Costa & Peralta 2015), but mentioned in Ochi (1980) and Allen (2002). Habitat: on the soil of slopes. It occurs in the Atlantic Forest and Caatinga (single record); 10-1700 m.

Plants small-sized, 1-1.7 mm high, light green to yellowish-green, leaves appressed to slightly imbricate, erect, distantly spaced or in inconspicuously rosulate tufts. Leaves slightly concave, lanceolate to ovate-lanceolate; apices green, acuminate; margins not bordered, entire to serrulate at apex, plane or recurved at base; costa strong, short-excurrent; upper cells narrowly rhomboidal, basal cells sub-quadrate to quadrate, non-porose, thick- and firm-walled. Axillary gemmae and bulbils occasionally present. Dioicous. Capsules green to orange-brown, pendulous to horizontal, pyriform to ovoid, neck short and broader than the urn; opercula conic-apiculate; peristome complete; exostome well-developed, endostome with segments well-developed, cilia present.

Selected specimens examined: **BRAZIL. Bahia:** Catu, 1/IV/1976, *D.M. Vital 5949* (SP); **Minas Gerais:** Santana do Riacho, 12/VI/2009, *P.E.A.S. Câmara 1945* (SP); **Paraná:** Quatro Barras, 17/XI/2012, *D.F. Peralta 12784* (SP); Tijucas do Sul, 13/VII/2004, *O. Yano 27963* (SP); **Pernambuco:** Taquaritinga do Norte, 24/VIII/1980, *O. Yano 2612* (SP); **Rio de Janeiro:** Parati, 20/VIII/1987, *D.M. Vital 15395* (SP); **Rio Grande do Sul:** Caxias do Sul, 13/I/2006, *J. Bordin 279* (SP); **São Paulo:** Campos do Jordão, 6/V/2012, *D.F. Peralta 12556* (SP); Cananéia, 13/V/2009, *D.F. Peralta 8016* (SP).

This is a weedy species (Allen 2002) distinguished by the thick leaf cell walls, pyriform to ovoid capsules with a broad neck, and by the occasional presence of axillary gemmae and bulbils. *Bryum dichotomum* could be confused with *B. subapiculatum* due to the leaf shape, width of cell walls, and scarcely bordered leaf margins. However, *B. subapiculatum* has hexagonal to narrowly romboidal upper leaf cells, rectangular to sub-quadrate basal cells, thin cell walls, conic to cylindric capsules with a slender neck, and lacks vegetative propagules (Fig. 10A-D). *Bryum dichotomum* is similar to *B. coronatum* due to the width of the neck. However, the latter has thin cell walls, oblong-cylindric capsules, corrugate neck, and does not produce gemmae (Fig. 5A-D). *Bryum dichotomum* and *B. orthodontioides* share the small-sized (1-2 mm high), imbricate, concave and elimbate leaves, and short-excurrent costa. However, this has thin leaf cell walls, capsules with a slender neck, and lacks vegetative propagules (Fig. 7A-D). *Bryum dichotomum* and *B. apiculatum* have axillary gemmae, but the latter presents narrowly hexagonal to fusiform leaf upper cells and abruptly larger rectangular to quadrate basal cells (Fig. 2A-E).

12. *Bryum huillense* Welw. & Duby, Mém. Soc. Phys. Genève 21: 221. pl 1: f. 5. 1872. *Rhodobryum huillense* (Welw. & Duby) Touw, J. Hattori Bot. Lab. 44: 150. 1978. Type: Angola. Huilla, *Welwitsch s.n.* (possible holotype BM000870818 image!, possible isotypes: G00050817 image!, H).

= *Rhodobryum glaziovianum* Hampe, Vidensk. Meddel. Naturhist. Foren. Kjøbenhavn, ser. 3, 6: 146. 1874. *Bryum glaziovianum* (Hampe) Hampe, Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn, ser. 4, 1: 103. 1879. Type: Brazil. Rio de Janeiro, *Glaziou 7051* (lectotype BM000960150 image! designated by Costa *et al*. (2016); isolectotypes: BM000960149 image!, PC0128546 image!), *syn. acc.* Ochi (1981).

Fig. 6F-J

Geographic distribution: Mexico, Central America, western South America; Africa; India (Allen 2002); and Brazil (moderate distribution: Mato Grosso*, Minas Gerais, Paraná*, Rio de Janeiro, and São Paulo). Habitat: on soil, rock, bark, and rotten logs. It is found in the Atlantic Forest and Amazon Forest biomes (rarely); 700-1900 m.

Plants large-sized to robust, 10-40 (60) mm high, light green to yellowish-green, leaves crisped and spirally-twisted when dry, in dense rosulate tufts, 2-4 distinctly storied rosettes. Leaves obovate to elliptic; apices green, mucronate; margins distinctly bordered by 3-5 rows of narrow, long-rectangular cells, conspicuously serrate at apex, plane or recurved at base; costa strong, short-excurrent; upper cells rhomboidal to rhomboidal-hexagonal, basal cells rectangular, porose, firm- and thin-walled. Dioicous. Capsules green to orange-brown, pendulous to horizontal, cylindric to conic, neck slender; opercula conic-apiculate; peristome complete; exostome well-developed, endostome with segments well-developed, cilia present.

Selected specimens examined: **BRAZIL. Mato Grosso:** Vila Bela da Santíssima Trindade, 19/VII/1977, *P.G. Windisch 1377* (SP); **Minas Gerais:** Itamonte, 22/V/1988, *D.M. Vital 15937* (SP); Poços de Caldas, 26/XI/2019, *B.K. Canestraro 1581* (SP); **Paraná:** Campina Grande do Sul, 15/I/2019, *B.K. Canestraro 1478* (SP); Morretes, 18/I/2001, *M.P. Petean 748* (SP); **São Paulo:** Campos do Jordão, 26/I/2019, *B.K.*

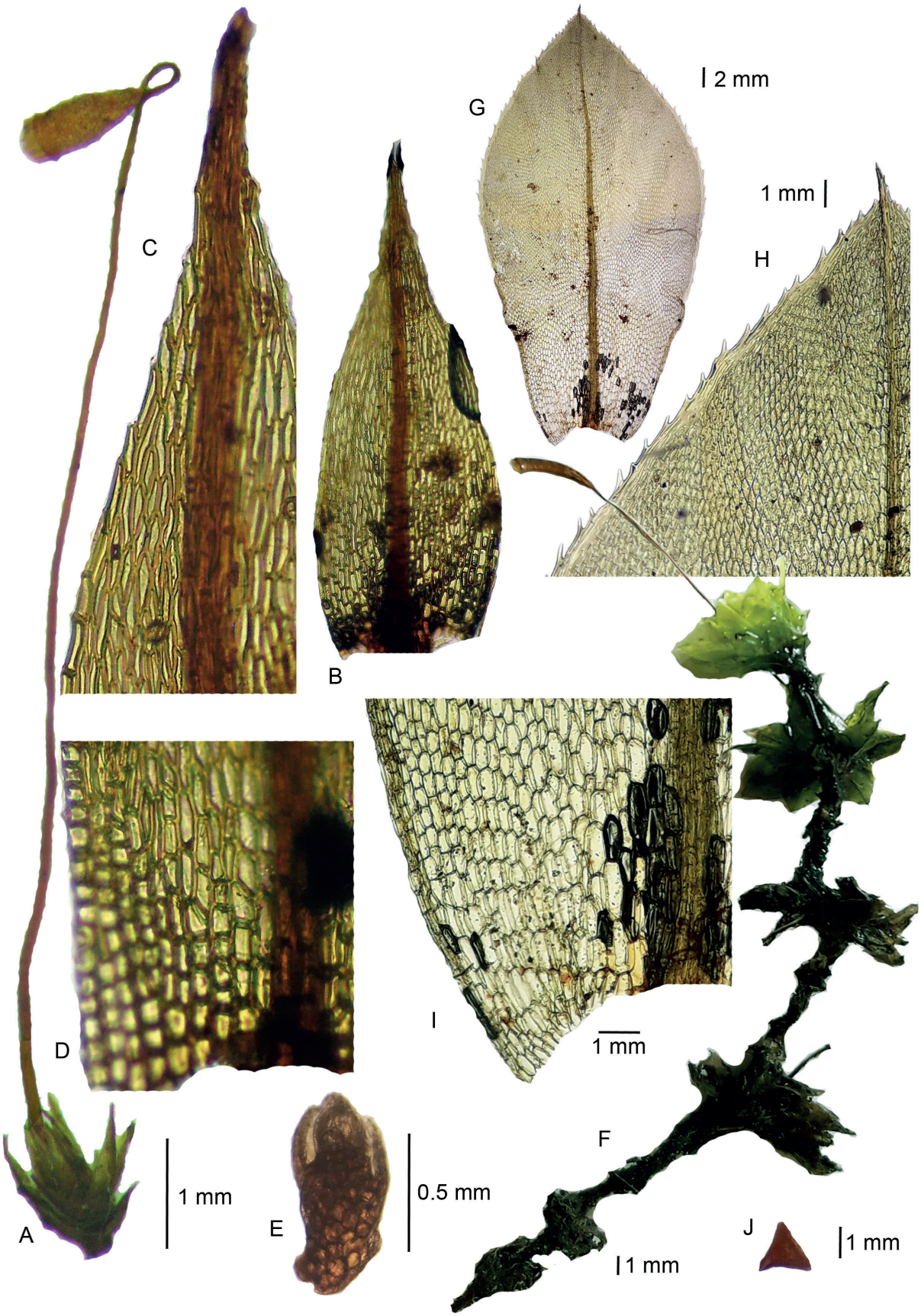

Figure 6. A-E. *Bryum dichotomum* (*D.F. Peralta 12784*, SP). **A**. Habit, wet. **B**. Vegetative leaf. **C**. Vegetative leaf apex. **D**. Vegetative leaf base. **E**. Axillary bulbil. **F-J**. *Bryum huillense* (F-I. *B.K. Canestraro 1478*, SP; J. *H.C. Sousa s.n.*, SP389565). **F**. Habit, wet. **G**. Vegetative leaf. **H**. Vegetative leaf apex. **I**. Vegetative leaf base. **J**. Operculum.

Canestraro 1521 (SP); Natividade da Serra, 6/IX/2009, *D.F. Peralta 9108* (SP).

This is a very distinct species among the Brazilian taxa of *Bryum*. It is large to robust in size (10-40 (60) mm high), leaves in dense rosulate tufts with 2-4 storied rosettes, obovate to elliptic leaves with distinctly bordered margins that are serrate at the apex, short-excurrent costa, and porose basal cells. Allen (2002) mentions filamentous axillary propagula in *B. huillense*. However, we did not observe this character among the Brazilian specimens. African and Asian individuals of this species are up to 3 cm high (vs. up to 6 cm in Neotropical samples) and show less morphological variation than the Neotropical individuals (Ochi 1972; 1974). This species can be confused with *B. billarderii* in having large-sized (15-25 (50) mm high), rosulate leaves, which are obovate, limbate and serrate at the apex. However, *B. billarderii* is smaller (medium- to large-sized), with leaves evenly spaced and crowded at the apex (when sterile) or in dense rosulate tufts, 1-2 (3) storied rosettes, margins bordered by 1-3 narrow cells, and single seta (Fig. 4A-D). Polysety was observed in a single specimen of *B. huillense*.

Bryum huillense may be confused with *Rhodobryum grandifolium* (Tayl.) Schimp. and *R. subverticillatum* Broth. due to the rosulate habit and obovate leaves (Allen 2002). However, *R. grandifolium* has 1-2 setae per perichaetium (vs. single seta per perichaetium in *B. huillense*), larger size (8 cm vs. 1-6 cm high in *B. huillense*), and larger leaves (8-12 mm vs. 5-7 mm long in *B. huillense*) (Allen 2002). *Rhodobryum subverticillatum* has more distinct and larger rosettes and leaf margins indistinct or with 2-3 rows of elongate cells (Ochi 1981; Koponen & Fuertes 2010).

13. *Bryum limbatum* Müll.Hal., Syn. Musc. Frond. 2: 573. 1851. Type: Costa Ri*ca*. In Reg. Montosa, *A.S. Oersted s.n.* (not indicated).

= *Bryum oediloma* var. *leptoloma* Broth., Ergebn. Bot. Exp. Südbras., Musci 295. 1924. Type: Brazil. Rio de Janeiro: Serra dos Órgãos, *Ule 143* (holotype H; isotypes: BM000763037 image!, BM000763038 image!, BM000763039 image!, L), *syn. acc.* Ochi (1980).

= *Bryum oediloma* Müll.Hal., Bihang til Kongliga Svenska Vetenskaps-Akademiens Handlingar 21 Afd. 3(3): 29. 1895. Type: Brazil. Prov. S. Paulo, Apiahy, ad saxa rivuli fertile, Puiggari 1852, 2033 (H? (hb-Broth.)); et asaxa cataracti fertile, *Puiggari 557* (H? (hb-Broth.)), Pasa Vinta, ad saxa ribuli, prope viam inter Apiahy et Iporanga, sterile, *Puiggari 1845* (H? (hb-Broth.)); Catas Altas da Ribeira, sterile, *Puiggari 1989* (H? (hb-Broth.)); Prov. S. Catharina, Minas, ad Saxa F. Tubarão fertile, *E. Ule 825* (H? (hb-Broth.)), *syn. acc.* Ochi (1980).

= *Bryum riograndense* E.B. Bartram, J. Washington Ac. Sc. 42(6): 180. 1952. Type: Brazil. Estação São Salvador, Montenegro, ad rupes rivuli, alt. 400m, *A. Sehnem 278* (PACA image!), *syn. acc.* Ochi (1980).

Fig. 7E-H

Geographic distribution: Neotropical (Allen 2002). In Brazil it has moderate distribution (Distrito Federal, Mato Grosso do Sul, Paraná, Rio de Janeiro, Rio Grande do Sul, Santa Catarina, and São Paulo). Habitat: on rock, soil and cement walls. It is recorded for the Atlantic Forest and Cerrado; 400-900 m.

Plants medium-sized, up to 30 mm high, dark green, leaves lax, crisped when dry, evenly spaced. Leaves ovate to broadly elliptic, inconspicuously decurrent; apices green, mucronate to cuspidate; margins distinctly bordered by 3-4 rows of narrow, long-rectangular cells, serrulate, recurved at base; costa strong when percurrent to short-percurrent, weak and evanescent when sub-percurrent; upper cells rhomboidal, basal cells rectangular, non-porose, base red, thin- and firm-walled. Dioicous. Capsules green to orange-brown, horizontal to suberect, pyriform, neck slender; opercula conic-apiculate; peristome complete; exostome well-developed, endostome with segments well-developed, cilia present.

Selected specimens examined: **BRAZIL. Distrito Federal:** Brasília, 20/I/2010, *R. Gama 580* (UB); **Mato Grosso do Sul:** Bonito, 2/VI/2002, *D.F. Peralta 2018* (SP); **Paraná:** Morretes, 25/VII/2014, *D.F. Peralta 16407* (SP); **Rio Grande do Sul:** Caxias do Sul, 15/IV/2010, *D.F. Peralta 10569* (SP); **Santa Catarina:** Bom Jardim da Serra, 28/III/2012, *T. Lobato 390* (SP); **São Paulo:** Piquete, 16/II/2000, *O. Yano 26169* (SP); Santo André, 1/VI/2018, *B.K. Canestraro 1209* (SP).

Bryum limbatum is characterized by lax and evenly spaced leaves, which are ovate to broadly elliptic, distinctly bordered by 3-4 rows of narrow cells, sub-percurrent to short-percurrent costa, and pyriform capsules. *Bryum limbatum* is similar to *B. riparioides* due to the sub-percurrent to percurrent costa. However, this has more elongate and oblong leaves and inconspicuously bordered margins (Fig. 9E-H). *Bryum renauldii* differs from *B. limbatum* in having usually entire and unbordered leaves (Fig. 9A-D). *Bryum* incrassatolimbatum Card. differs from *B. limbatum* by its multistratose and entire leaf margins (Allen 2002).

14. *Bryum orthodontioides* Müll.Hal., Syn. Musc. Frond. 1: 293. 1848. Type: Brazil. *Sellow s.n.* (syntypes: BM000873774!, BM000873775!).

= *Bryum leptocladon* Sull., Proc. Amer. Acad. Arts 5: 282. 1861. Type: Cuba, *Wright 62* (holotype NY; isotypes: BM000873789 image!, JE, L), *syn. nov.*

= *Bryum fabroniopsis* Müll.Hal., Hedwigia 34: 127. 1895. *Anomobryum fabroniopsis* (Müll.Hal.) Broth., Natürl. Pflanzenf. I(3): 563. 1903. Type: Brazil. (Goiás), *E. Ule 1534* (possible holotype B, isotype R000081212 image!, H), *syn. acc.* Ochi (1980).

Fig. 7A-D

Geographic distribution: Central America, Caribbean (Allen 2002) and Brazil (moderate distribution: Goiás, Mato

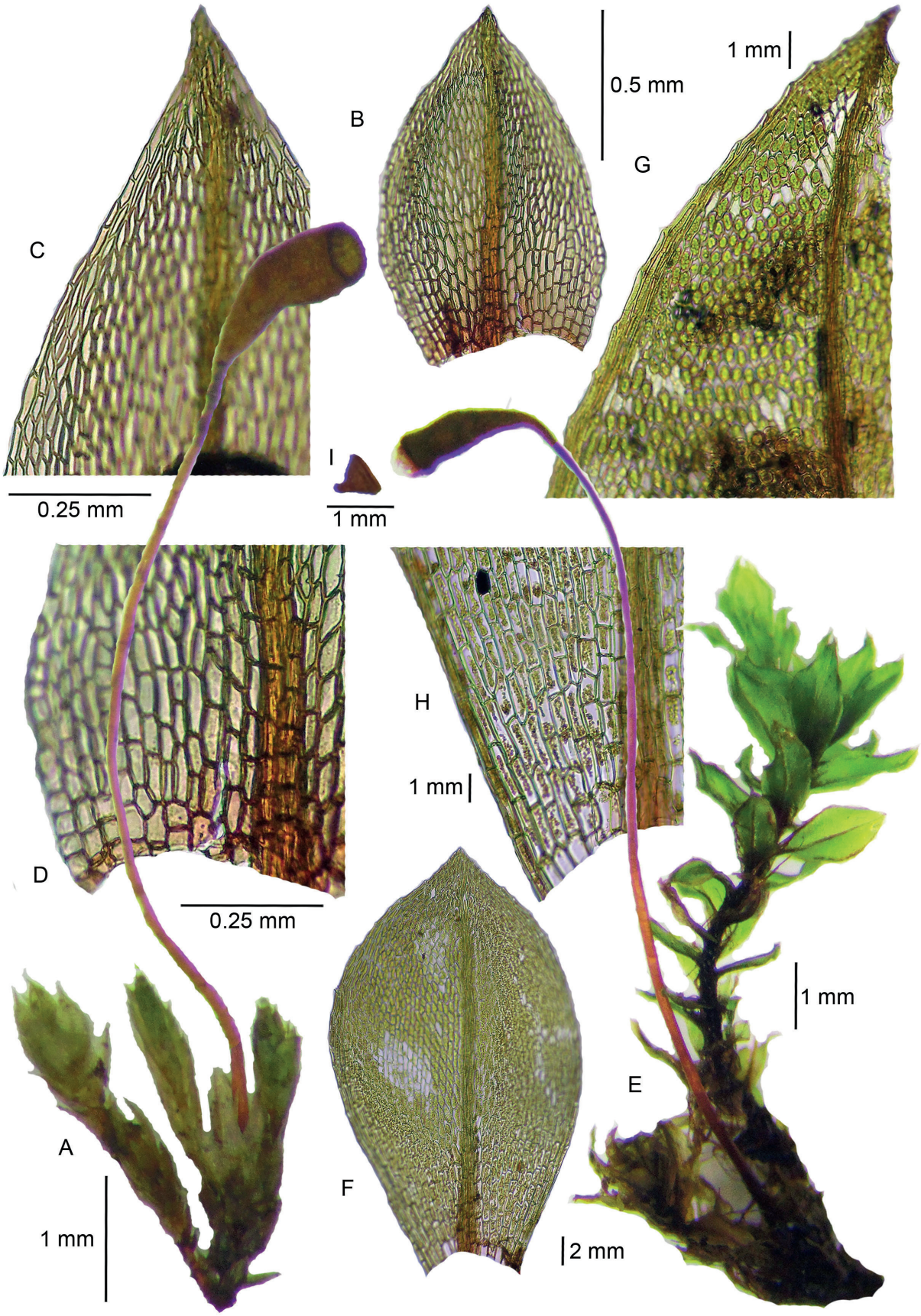

Figure 7. A-D. *Bryum orthodontioides* (*D.F. Peralta 5510*, SP). **A**. Habit, wet. **B**. Vegetative leaf. **C**. Vegetative leaf apex. **D**. Vegetative leaf base. **E-H**. *Bryum limbatum* (*B.K. Canestraro 1209*, SP). **E**. Habit, wet. **F**. Vegetative leaf. **G**. Vegetative leaf apex. **H**. Vegetative leaf base.

Grosso*, Minas Gerais, Rio de Janeiro*, Santa Catarina, and São Paulo*). Habitat: on soil and rock. It is observed in the Atlantic Forest and Cerrado; 400-1600 m.

Plants small-sized, up to 3 mm high, light green, yellowish-green to reddish-green, leaves lax or usually imbricate, erect, evenly spaced. Leaves plane or concave, ovate-lanceolate; apices green, mucronate to cuspidate; margins not bordered or inconspicuously bordered by one row of narrow, rectangular cells, entire, plane; costa strong, short-excurrent; upper cells rhomboidal, lax-walled, basal cells rectangular to sub-quadrate, non-porose, thin- and firm-walled. Dioicous. Capsules green to orange-brown, horizontal to suberect, pyriform, cylindric to conic, neck slender; opercula conic-apiculate; peristome complete; exostome well-developed, endostome with segments well-developed, cilia present.

Selected specimens examined: **BRAZIL. Mato Grosso:** Cuiabá, 17/IV/2003, *F.P. Athayde Filho 1220* (SP); Nova Xavantina, 27/XI/2011, *P. Fetter 805* (SP); **Minas Gerais:** Santa Bárbara, 18/IX/1977, *D.M. Vital 7676* (SP); **Rio de Janeiro:** Penedo, 10/VII/1991, *D.M. Vital s.n.* (SP387684); **Santa Catarina:** Urubici, 16/XII/2017, *B.K. Canestraro 1140* (SP); **São Paulo:** Bofete, 24/VII/2007, *D.F. Peralta 5510* (SP); Cajuru, 23/III/1982, *D.M. Vitt 10377* (SP).

Among the Brazilian *Bryum* species, *B. orthodontioides* exhibits the smallest gametophyte (up to 3 mm high) and leaves. This species is also distinguished by the usually imbricate and concave leaves, leaf margins entire and unbordered, short-excurrent costa, lax upper cell walls, and horizontal to suberect capsules. Some sterile individuals of *B. orthodontioides* present more elongate stems and lax leaf arrangement. After careful analysis of the type material of *B. orthodontioides*, we noticed that this species is conspecific to *B. leptocladon*. According to the principle of priority of the International Code of Nomenclature for algae, fungi and plants (Turland *et al*. 2018), we reduce *B. leptocladon* to a synonym of *B. orthodontioides*.

Bryum orthodontioides seems to *B. apiculatum* due to the lanceolate leaves with cuspidate apex, unbordered margins, short-excurrent costa, and rectangular to sub-quadrate basal cells. However, *B. apiculatum* has more elongate leaves with serrulate apices, red base, narrowly hexagonal to fusiform upper cells, and abruptly larger, rectangular to quadrate basal cells (Fig.2A-E). *Bryum orthodontioides* is similar to *B. subapiculatum*, but the latter has leaves with serrulate margins, firm cell walls, and pendulous and conic to cylindric capsules (Fig. 10A-D). The species is also close to *B. dichotomum* because both have small-sized (1-2 mm high), imbricate leaves, and short-excurrent costa. However, *B. dichotomum* has thick cell walls, broad capsules neck, and vegetative propagules (Fig. 6A-E).

Bryum mattogrossense Broth. (H3300458 image!) may be conspecific to *B. orthodontioides*. Both species are dioicous and have small-sized (*ca*. 1.0 mm long), imbricate and appressed leaves, unbordered or inconspicuously bordered margins, short-excurrent costa, and rectangular basal cells (Ochi 1980). However, the type material of *B. mattogrossense* lacks sporophyte. Further studies are needed to confirm this hypothesis.

15. *Bryum pabstianum* Müll.Hal., Bot. Zeit. (Berlin) 13: 751. 1855. Type: Brazil. Santa Catarina, (Florianópolis), *Pabst 657* (syntypes: JE04003383 image!, JE04003384 image!, BM000721139 image!, BM000721142 image!, G00047964 image!, NY01178365 image!, H).

= *Bryum gardneri* Mitt., Hooker's J. Bot. Kew Gard. Misc. 8: 233. 1856. Type: Brazil. Rio de Janeiro: (Serra dos Órgãos), *Gardner 37* (holotype NY01178071 image!), *syn. acc.* Ochi (1980).

= *Bryum polygamum* Hampe, Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn 2: 275. 1869-70. Type: Brazil. Lagoa Santa, *Warming s. n.* (holotype BM000873771 image!), *syn. acc.* Ochi (1980).

= *Bryum puiggarii* Geh. et Hampe, Flora 64: 376. 1881. Type: Brazil. São Paulo: (Apiaí), *Puiggari 449* (possible holotype BM000873765 image!, isotypes: G00280995 image!, H, L,), *syn. acc.* Ochi (1980).

Fig. 8A-D

Geographic distribution: Colombia, Peru, Bolivia, Falkland Islands (Ochi 1980; Rangel 2008) and Brazil (moderate distribution: Bahia, Espírito Santo, Goiás, Minas Gerais, Paraná, Rio de Janeiro, Santa Catarina, and São Paulo). Habitat: on soil (including sandy soil), rock, bark, rotten logs, and burned wood. It is distributed in the Atlantic Forest, Cerrado, and Caatinga biomes; 20-1900 m.

Plants small- to medium-sized, up to 10 mm high, light green to yellowish-green, leaves imbricate or lax, erect, plane, evenly spaced. Leaves oblong, lanceolate to ovate-lanceolate; apices green, acuminate; margin not bordered, serrulate at apex, plane at base; costa strong, short-excurrent; upper cells rhomboidal-hexagonal, basal cells rectangular, non-porose, firm- and thin-walled. Synoicous. Capsules green to orange-brown, pendulous, cylindric to conic, neck slender; opercula conic-apiculate; peristome complete; exostome well-developed, endostome with segments well-developed, cilia present.

Selected specimens examined: **BRAZIL. Bahia:** Morro do Chapéu, 3/IV/1976, *D.M. Vital 6043* (SP); **Espírito Santo:** Itapemirim, 25/VII/1989, *A. Schäfer-Verwimp 11590* (SP); Ponta da Fruta, 1/VII/1981, *O. Yano 3480* (SP); **Goiás:** near Alto Paraíso, 18/III/1971, *H.S. Irwin 32138* (UB); Cristalina, 17/V/1976, *D.M. Vital 6263* (SP); **Minas Gerais:** Itabirito, 27/VII/1977, *D.M. Vital 7486* (SP); **Paraná:** Prudentópolis, 8/VII/2013, *R. Ristow 3259* (SP); Quatro Barras, 17/XI/2012, *D.F. Peralta 12798* (SP); **São Paulo:** Campos do Jordão, 24/I/2019, *B.K. Canestraro 1485* (SP); Juquitiba, 14/VII/1977, *D.M. Vital 7145* (SP).

Bryum pabstianum has synoicous inflorescences, unbordered leaves with serrulate apices, short-excurrent costa, and conic to cylindric capsules. This species can be

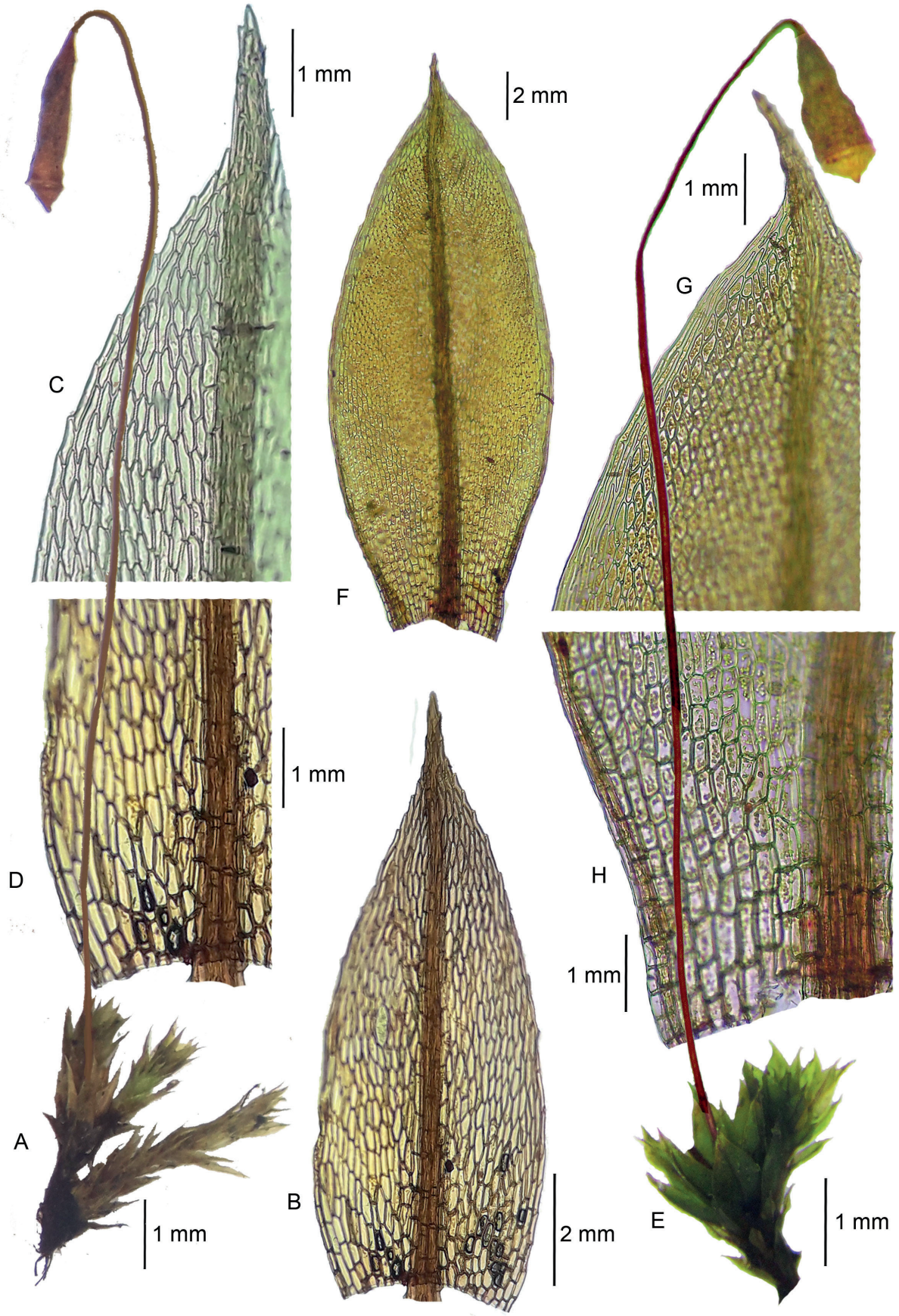

Figure 8. A-D. *Bryum pabstianum* (*D.F. Peralta 12798*, SP). **A**. Habit, wet. **B**. Vegetative leaf. **C**. Vegetative leaf apex. **D**. Vegetative leaf base. **E-H**. *Bryum pallescens* (*B.K. Canestraro 1446*, SP). **E**. Habit, wet. **F**. Vegetative leaf. **G**. Vegetative leaf apex. **H**. Vegetative leaf base.

confused with *B. subapiculatum* due to the gametophyte aspect and shape of the leaves. However, this has dioicous inflorescences, and rectangular to sub-quadrate basal leaf cells (Fig. 10A-D). Ochi (1980) pointed out that *B. pabstianum* and *B. subapiculatum* have rhizoidal gemmae and the shape and size of the gemmae are a diagnostic feature. This character was not observed in both examined material, therefore we consider the best diagnostic feature is sexuality. *Bryum pallescens* is also synoicous. However, it has recurved and distinct bordered leaf margins (Fig. 8E-H). The gametophyte aspect and leaf shape of *B. pabstianum* also resemble *B. coronatum*. However, the last has ovate-lanceolate leaves with long-excurrent costa, oblong-cylindric capsules, and a broad neck (Fig. 5A-D).

16. *Bryum pallescens* Schleich. ex Schwägr., Sp. Musc. Frond., Suppl. 1(2): 107. pl. 75. 1816. *Ptychostomum pallescens* (Schleich. ex Schwägr.) J.R. Spence, Phytologia 87(1): 21. 2005. *Bryum pseudotriquetrum* subsp. *pallescens* (Schleich. ex Schwägr.) Dixon, Stud. Handb. Brit. Mosses (ed. 3): 364. 1924. Type: Germany, Switzerland, Austria. *Schleicher* et *Car. Ludwig* (holotype G).

Fig. 8E-H

Geographic distribution: Subarctic America; North America; Central America; western and southern South America; maritime Antarctica; Europe; Asia, Africa; New Zealand (Allen 2002; Ochyra & Bednarek-Ochyra 2015) and Brazil (first record for Brazil, moderate distribution: Espírito Santo*, Minas Gerais*, Paraná*, Rio de Janeiro*, and Santa Catarina*). Habitat: on rock and soil. It is exclusive to the Atlantic Forest biome; 850-1900 m.

Plants medium to large-sized, up to 30 mm high, light green to dark green to reddish-green, leaves imbricate, crisped when dry, evenly spaced or in inconspicuously rosulate tufts. Leaves ovate, ovate-lanceolate to elliptic; apices green, acuminate or cuspidate; margins distinctly bordered by 2-4 rows of narrow, long-rectangular cells, entire to serrulate at apex, usually recurved at base; costa strong, short-excurrent; upper cells rhomboidal-hexagonal, thin-walled, basal cells rectangular, non-porose, firm- and thick-walled. Synoicous. Capsules green to orange-brown, pendulous, cylindric to conic, neck slender; opercula conic-apiculate; peristome complete; exostome well-developed, endostome with segments well-developed, cilia present.

Selected specimens examined: **BRAZIL. Espírito Santo:** Conceição do Castelo, 13/X/1988, *A. Schäfer-Verwimp 10277* (SP); Dores do Rio Preto, 11/V/2015, *M. Fornazier 11* (SP); **Minas Gerais:** Itamonte, 5/VII/1991, *D.M. Vital 19690* (SP); Itatiaia, 24/XI/2011, *O. Yano 33184* (SP); **Paraná:** Guaratuba, 2/XI/2018, *B.K. Canestraro 1446* (SP); Tibagi, 7/VII/2013, *E.D. Lozano 1318* (SP); **Rio de Janeiro:** Itatiaia, 22/X/2005, *D.F. Peralta 2862* (SP); Resende, 22/VI/2005, *O. Yano 7650* (SP); **Santa Catarina:** Cabo de Santa Marta, 17/XI/1979, *O. Yano 2205* (SP); Urubici, 31/VI2017, *O. Yano 34288* (SP).

Bryum pallescens is a synoicous and medium- to large-sized (up to 30 mm high) plant with leaves imbricate, crisped, ovate-lanceolate to elliptic, distinctly limbate and recurved margins, short-excurrent costa, and thick basal cell walls. This species is reported for high altitudes (Ochi 1982). *Bryum pallescens* is very variable in gametophyte size and can also be autoicous, but the most easily distinguishable character is its sexuality (Ochi 1959; Allen 2002). Peralta *et al*. (2008) and Yano & Peralta (2011a) made the two first records of *B. pallescens* in Brazil (*Pirani 1575* - SP230701!; *Yano 21790* - SP274708!, respectively). However, the correct identifications are *B. coronatum* and *B. subapiculatum*, respectively. Therefore, we actually present the first record of *B. pallescens* for the country.

This species is similar to *B. capillare* by the imbricate and crisped leaves. However, *B. pallescens* is dioicous, the leaf margins are usually plane, and the upper cell walls are lax (Fig. 4E-I). *Bryum pallescens* and *B. limbatum* have distinctly limbate leaves. However, the latter has thin-walled basal cells, dioicous inflorescences and horizontal to sub-erect and pyriform capsules (Fig. 7E-H). *Bryum pallescens* and *B. pabstianum* are synoicous. However, the latter has plane and unbordered leaf margins (Fig. 8A-D). *Bryum pallescens* may be confused with *B. pseudotriquetrum* (Hedw.) Gaertn. However, the latter has decurrent leaves, percurrent to short-excurrent costa, and dioicous inflorescences (Allen 2002). This species was excluded from Brazil in the present study (see excluded species section).

17. *Bryum renauldii* Röll, Bull. Soc. Roy. Bot. Belgique 38 (Mém.): 13–14. 1899(1900). Type: Costa Rica, Sanchez probe San José, *Sarg s.n.* (possible holotype in PC: PC0136126 image!, PC0136127 image!, PC0136128 image!, isotype H3301731 image!).

Fig. 9A-D

Geographic distribution: Mexico, Central America, Caribbean, western South America (Allen 2002) and Brazil (moderate distribution: Distrito Federal*, Minas Gerais, Paraná*, Rio de Janeiro, and São Paulo). Habitat: on soil and submerged and emerged rocks along streams. It occurs in the Atlantic Forest and Cerrado biomes; 200-1200 m.

Plants medium-sized, up to 25 mm high, green to yellowish-brown, leaves lax, contorted when dry, evenly spaced. Leaves ovate to elliptic, inconspicuously decurrent; apices green, obtuse; margins not or inconspicuously bordered by one row of narrow rectangular cells, entire or denticulate at the apex, recurved at base; costa weak, evanescent, subpercurrent; upper cells rhomboidal, basal cells rectangular, non-porose, firm- and thin-walled. Dioicous or synoicous. Sporophyte unknown.

Selected specimens examined: **BRAZIL. Distrito Federal:** Gama, 28/XI/2000, *D. Pereira s.n.* (SP507251); antes do Poço Azul, 24/II/2002, *A.S. Rodrigues 74* (SP); **Minas Gerais:** Diamantina, 14/XI/2010, *O. Yano 32964* (SP); **Paraná:** Guaíra, 21/X/1983, *D.M. Vital 11238* (SP); **Rio**

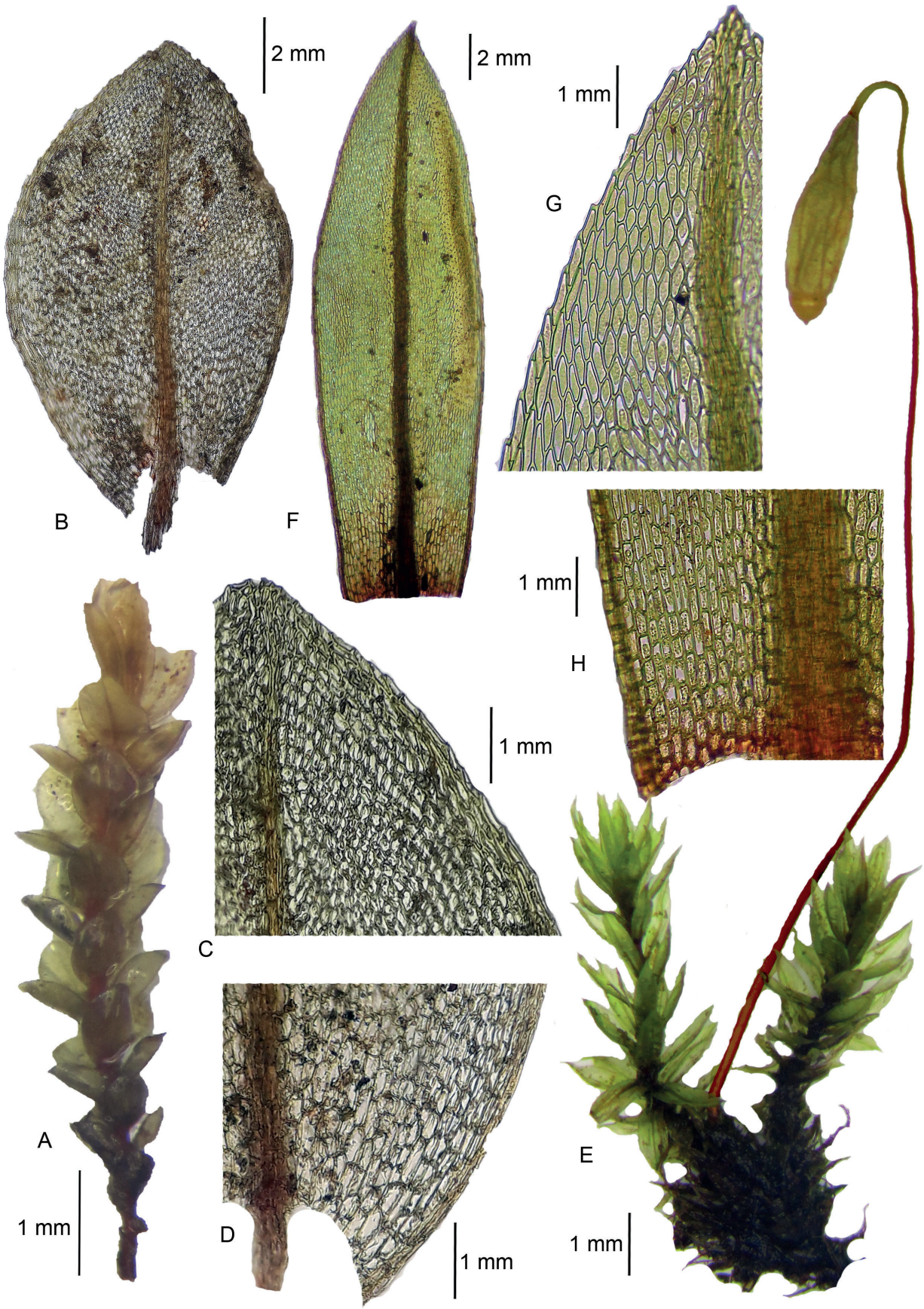

Figure 9. A-D. *Bryum renauldii* (*D.F. Peralta 1482*, SP). **A**. Habit, wet. **B**. Vegetative leaf. **C**. Vegetative leaf apex. **D**. Vegetative leaf base. **E-H**. *Bryum riparioides* (*D.F. Peralta 20695*, SP). **E**. Habit, wet. **F**. Vegetative leaf. **G**. Vegetative leaf apex. **H**. Vegetative leaf base.

de Janeiro: Angra dos Reis, 16/V/1995, *M.I.M.N. Oliveira-e-Silva 4198* (SP); **São Paulo:** Neves Paulista, 12/X/1996, *K.M. Pereira 9* (SP); Ubatuba, 27/II/2003, *D.F. Peralta 1482* (SP).

Bryum renauldii is characterized by lax and evenly spaced leaves, which are ovate to elliptic, with obtuse apices, unbordered margins, weak, and evanescent and subpercurrent costa. During the herbaria and fieldwork, we could not find sporophytes, but we did observe sex organs. We analyzed eight specimens for Brazil, of which six were dioicous, one synoicous, and three unknown. Spence (2015) mentioned it is "apparently dioicous". Therefore, this is the first description of the sexuality of *B. renauldii* (Ochi 1980; 1994; Allen 2002). Besides this observation by Spence (2015), previous studies mentioned that the sporophyte is unknown (Ochi 1980; 1994; Allen 2002), and we could not find any information about the sporophytic generation of this species.

This species is similar to *B. limbatum* in having weak, evanescent and sub-percurrent costa, but the latter has distinctly limbate leaves and serrulated leaf margins (Fig. 7E-H). It is also close to *B. incrassatolimbatum*, but this has lax upper leaf cells and multistratose leaf margins (Allen 2002).

18. *Bryum riparioides* E.B. Bartram, J. Wash. Acad. Sci. 42(6): 180. 1952. Type: Brazil. Rio Grande do Sul, São Francisco de Paula, *A. Sehnem 2739* (holotype FH-Bartr.; isotypes: HAS13422!; PACA74209 image!, R140491).

Fig. 9E-H

Geographic distribution: endemic to Brazil (rare distribution: Minas Gerais*, Paraná*, Rio Grande do Sul, and São Paulo*). Habitat: on rocks and rocks along streams. It is observed in the Atlantic Forest, Pampa and, rarely, in the Cerrado biome; 150-1050 m.

Plants large-sized, 10-20 mm high, dark green, leaves imbricate, erect, evenly spaced. Leaves plane to slightly concave, oblong, narrowly elliptic to narrowly lanceolate; apices green, mucronate; margins not bordered or bordered by 1-2 rows of narrow, long-rectangular cells at base, serrulate at apex, recurved almost throughout; costa weak, evanescent, sub-percurrent to percurrent; upper cells rhomboidal, thin-walled, basal cells sub-quadrate to rectangular, non-porose, red, firm- and thick-walled. Dioicous. Capsules green to orange-brown, pendulous to horizontal, cylindric to conic, neck slender; opercula conic-apiculate; peristome complete; exostome well-developed, endostome with segments well-developed, cilia present.

Selected specimens examined: **BRAZIL. Minas Gerais:** Caldas, 25/V/1986, *A. Schäfer-Verwimp 7046* (SP); **Paraná:** Guaíra, 5/X/1978, *D.M. Vital 8356* (SP); Pinhão, 21/X/1996, *F. Straube s.n.* (SP284164); **Rio Grande do Sul:** Alegrete, 8/IX/2018, *F. Gonzatti 4596* (SP); Montenegro, XI/1950, *A. Sehnen 4995* (HAS); **São Paulo:** Barra do Turvo, 5/XII/1973, *D.M. Vital 2783* (SP); São Luís do Paraitinga, 7/IX/2009, *D.F. Peralta 9284* (SP).

Bryum riparioides is a large plant (10-20 mm high) and has imbricate, elongate and slightly concave leaves, serrulate, recurved and indistinctly bordered margins, weak, evanescent and sub-percurrent to percurrent costa, and thick-walled basal cells. *Bryum riparioides* and *B. limbatum* share the sub-percurrent to percurrent costa, and recurved leaf margins. However, the last has wider leaves (ovate to broadly elliptic), distinctly bordered margins and pyriform capsules (Fig. 7E-H). The species is also similar to *Imbribryum alpinum* (Huds. ex With.) N. Pedersen, but the latter has conspicuously imbricate, smaller and narrower leaves, with acute apex, and narrow and vermicular upper cells (Spence 2015). *Bryum riparioides* is commonly confused with *Imbribryum muehlenbeckii* (Bruch & Schimp.) N. Pedersen. However, the latter has smaller, ovate and conspicuously concave leaves with a decurrent base and weak costa (Ochi 1980; Spence 2015). This species was excluded from Brazil (see excluded species).

This species is endemic to Brazil (Matteri 2003; Larraín 2016). *Bryum riparioides* was described by Bartram (1952) and recorded for Brazil by Yano (1981; 2011) and Bordin & Yano (2010). The name was rarely mentioned in the literature, and after careful analysis, we decided to reestablish the name.

19. *Bryum subapiculatum* Hampe, Vidensk. Meddel. Dansk Naturhist. Foren. Kjobenhavn, 4(1–5): 51. 1872. Type: Brazil. Rio de Janeiro, São Cristóvão, *Glaziou 5148* (lectotype BM000763014 designated by Costa *et al.* (2016); isolectotypes: PC0738970 image!, PC0709488 image!, PC0013429, BM000763015, BM000763016, BM000763017).

= *Bryum* dentiferum Hampe, Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn. ser. 3 9-10: 262. 1878. Type: Brazil. Rio de Janeiro, *Glaziou 8516* (lectotype BM000873697! designated by Costa *et al.* (2016); isolectotypes: BM000873696!, BM000873698!, PC0136564!, PC0709492!, PC0721186!), *syn. acc.* Ochi (1980).

= *Bryum oncophorum* Hampe, Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn. ser. 3, 10: 262. 1878. Type: Brazil. Rio de Janeiro, *Glaziou 7901* (lectotype BM000873776 image! designated by Costa *et al.* (2016); isolectotype: PC0709467 image!), *syn. nov.*

Fig. 10A-D

Geographic distribution: North America, Neotropics, southern South America; Europe; Asia; Africa; Australia, New Zealand (Ochi 1980; Allen 2002) and Brazil (moderate distribution: Minas Gerais, Paraná, Rio de Janeiro, Rio Grande do Sul, Roraima, Santa Catarina*, and São Paulo). Habitat: on rock, soil (including sandy soil), bark, and rotting logs. It is distributed in the Atlantic Forest, Cerrado, Amazon Forest, and Pampa (single record) biomes; 10-2100 m.

Plants small- to medium-sized, 4-10 mm high, light green, dark green to reddish-green, leaves imbricate or

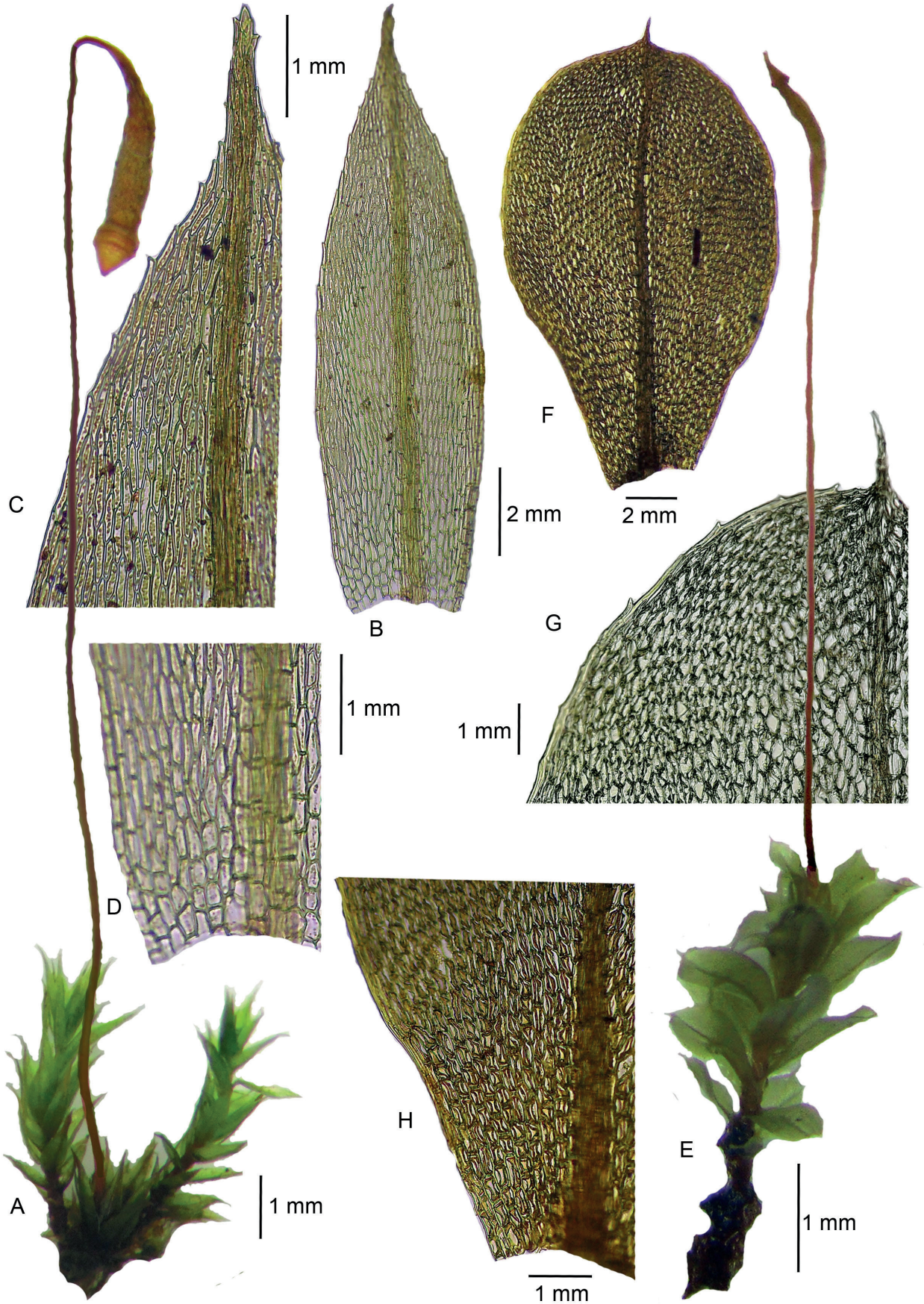

Figure 10. A-D. *Bryum subapiculatum* (*D.F. Peralta 22603*, SP). **A**. Habit, wet. **B**. Vegetative leaf. **C**. Vegetative leaf apex. **D**. Vegetative leaf base. **E-H**. *Bryum wrightii* (*W. Thomas s.n.*, SP280839). **E**. Habit, wet. **F**. Vegetative leaf. **G**. Vegetative leaf apex. **H**. Vegetative leaf base.

lax, erect, plane, evenly spaced. Leaves oblong, lanceolate to ovate-lanceolate; apices green, acuminate or cuspidate; margins not bordered, serrulate at the apex, plane; costa strong, short-excurrent; upper cells hexagonal-rhomboidal to narrowly romboidal, basal cells rectangular to subquadrate, non-porose, firm- and thin-walled. Dioicous. Capsules orange-brown to reddish-brown, pendulous to horizontal, cylindric to conic, neck slender; opercula conic-apiculate; peristome complete; exostome well-developed, endostome with segments well-developed, cilia present.

Selected specimens examined: **BRAZIL. Minas Gerais:** Itamonte, 10/VI/2015, *D.F. Peralta 17474* (SP); Nova Lima, 28/VII/2010, *D.F. Peralta 11841* (SP); **Paraná:** Guarapuava, 16/I/2018, *B.K. Canestraro 1195* (SP); Quatro Barras, 30/XII/2018, *B.K. Canestraro 1471* (SP); **Rio de Janeiro:** Teresópolis, 21/III/2017, *D.F. Peralta 20372* (SP); **Rio Grande do Sul:** Caxias do Sul, 6/V/2007, *M. Sartori 183* (SP); Palmares do Sul, 27/XI/2011, *F. Gonzatti 284* (SP); **Roraima:** Caracaraí, 28/VII/1974, *D. Griffin III 672* (SP); **Santa Catarina:** Rancho Queimado, 17/XII/2017, *B.K. Canestraro 1152* (SP); **São Paulo:** Barra do Turvo, 15/V/2009, *D.F. Peralta 8177* (SP); Cunha, 23/VI/2006, *D.F. Peralta 3996* (SP).

Bryum subapiculatum has evenly spaced leaves, usually ovate-lanceolate leaves, unbordered and serrulated margins, short-excurrent costa, thin-walled cells, and a slender capsule neck. Some authors (Ochi 1980; 1994; Allen 2002) mention that the species presents rhizoidal propagula, but it was not possible to observe this structure in the Brazilian collection.

This species is very close to *B. pabstianum*, but the latter has synoicous inflorescences and rectangular basal leaf cells (see comments of *B. pabstianum*; Fig.8A-D). The lanceolate, plane, and evenly spaced leaves of *B. subapiculatum* are similar to *B. coronatum* and *B. apiculatum*. The latter has oblong-cylindric capsules with a corrugate and broad neck (Fig. 5A-D). The latter has narrowly hexagonal to fusiform upper leaf cells, abruptly larger and rectangular basal cells, red leaf base, occasionally axillary gemmae (Fig. 2A-E). *Bryum subapiculatum* is similar to *B. dichotomum*, but it has thick-walled cells, pyriform to ovoid capsules, broad neck, and axillary propagula (Fig. 6A-E). *Bryum subapiculatum* is close to *B. orthodontioides*. However, the latter has entire margins, lax-walled upper cells, and horizontal to suberect and pyriform capsules (Fig. 7A-D). *Brym subapiculatum* resembles *Pohlia elongata* Hedw. due to the leaf and gametophyte aspect. However, *Pohlia elongata* has longer and narrower upper cells, with a 4:1 proportion, thick cell walls, and a more elongate capsule (Allen 2002).

Hodgetts *et al*. (2020) recently proposed a new combination for *B. subapiculatum* to *Imbribryum subapiculatum* (Hampe) D. Bell & Holyoak based on data published by Bell *et al*. (2013). However, Bell *et al*. (2013) make no mention of *B. subapiculatum* among the species studied or any one of its synonyms. Therefore, we decided to maintain this name in *Bryum*.

20. *Bryum wrightii* Sull. & Lesq., Char. New Musci, U.*S.N.* 4. 1859. *Ptychostomum wrightii* (Sull. & Lesq.) J.R. Spence, Phytologia 87(1): 22. 2005. *Plagiobryum wrightii* (Sull. & Lesq.) N. Pedersen, Bryologist 108: 127. 2005. *Brachymenium wrightii* (Sull.) Broth., Nat. Pflanzenfam. I(3): 559. 1903. *Leptotheca wrightii* Sull., Proc. Amer. Acad. Arts 5: 281. 1861. Type: Cuba, Wright 53 (holotype NY00667903 image!; isotypes: BM000873593 image!, BM000873594 image!, BM000873595 image!, BM000873596 image!, BM000873597 image!, E0001386 image!, G00113812 image!, G00113813 image!, G00113814 image!, G00280104 image!, GOET012305 image!, JE04003155 image!, H3301173 image!, MICH525833 image!, L).

Fig. 10E-H

Geographic distribution: Mexico, Central America, Caribbean (Allen 2002) and Brazil (rare distribution: Bahia). Habitat: on barks. It occurs in the Atlantic Forest and Caatinga biomes; 100-200 m.

Plants medium-sized, 5-15 mm high, light green to yellowish-green, leaves lax, contorted when dry, evenly spaced or in inconspicuously rosulate tufts. Leaves orbiculate to obovate; apices green, cuspidate; margins distinctly bordered by 2-3 row of narrow, long-rectangular cells, serrulate at the apex, recurved at base; costa weak, evanescent, short-excurrent; upper cells rhomboidal-hexagonal, basal cells rectangular, non-porose, firm- and thin-walled. Dioicous. Capsules green to orange-brown, erect, cylindric to conic, neck slender; opercula high-conic, beaked; peristome reduced; exostome well-developed, endostome segments reduced to rudimentary, cilia rudimentary to absent.

Selected specimens examined: **BRAZIL. Bahia:** Santa Teresinha, 6/X/1994, *C.W.N. Moura s.n.* (SP283923); Uruçuca, 19/VII/1993, *W. Thomas 9861* (SP).

Bryum wrightii is very distinct with orbicular to obovate leaves, weak, evanescent and short-excurrent costa, erect capsules, high-conic and beaked opercula and reduced peristome. This species is similar to *B. limbatum* due to the broad and bordered leaf margin. However, it has sub-percurrent to percurrent costa, pendulous capsules, and well-developed endostome segments (Fig. 7E-H).

Bryum wrightii has been positioned in different genera, such as *Brachymenium* (Brotherus 1903; Ochi 1980), *Plagiobryum* (Pedersen & Hadenas 2005), and *Ptychostomum* (Spence 2005). However, based on molecular data, some species of *Ptychostomum* and *Plagiobryum* are nested within *Bryum*, as *B. wrightii* (Frey & Stech 2009). Therefore, *Bryum wrightii* is adopted.

Taxa excluded from Brazil (21)

Anomobryum prostratum (Müll.Hal.) Besch., Mém. Soc. Nat. Cherbourg 16: 200. 1872.

This species was recorded by Brotherus (1924) based on *Ule 426*. However, it was not possible to locate this specimen. The records of Yano & Peralta (2008) (*Vital 11757* - SP206143!) correspond to *Anomobryum julaceum*. Ochi (1980) does not cite specimens from Brazil and the records of this species are only from the western Andes.

Bryum atrovirens Brid. Muscol., Recent 2(3): 48. 1803.

Yano (1981) and Costa *et al*. (2005) mentioned this species for Rio de Janeiro. However, Costa *et al*. (2005) indicated the species data are deficient and did not present the voucher. It was not possible to consult the literature cited by Yano (1981) for this species.

Bryum atroviride Herzog, Rep. Spec. Nov. Regn. Veg. 21: 30. 1925.

This is a synonym of *Bryum laevigatum*, and this taxon does not occur in Brazil.

Bryum caespiticium Hedw., Sp. Musc. Frond.180–181. 1801.

The records for Brazil by Yano *et al*. (2010) (*Guimarães s.n*. - SP241993!; *Bastos s.n*. (SP260965!; *Vital 20069* - SP353817!) and Yano & Peralta (2008) (*Tomita s.n*. - SP223199!) are in fact *Bryum atenense*. The records by Yano *et al*. (2019) based on *Vital 10944* (SP173015!) and *Peralta 8016* (SP413452!) are *B. coronatum* and *B. dichotomum*, respectively. Costa *et al*. (2005) also recorded the species but did not mention any vouchers.

Bryum canariense Brid., Muscol. Recent. Suppl. 3: 29. 1817.

The species was cited by Costa & Peralta (2015) for Mato Grosso (*Schafer-Verwimp 8622* - SP507027!). However, the correct identification is *B. billarderii*.

Bryum cellulare Hook., Sp. Musc. Frond., Suppl. 3 (1,1): pl. 214, f. a. 1827.

It was recorded for Minas Gerais by Ochi (1980) based on the type of *B. acanthoneuron* Aongstr. of *Henschen s.n*. (BM000873718 image!). Ochi (1980) considered *B. acanthoneuron* a synonym of *B. cellulare*. Nonetheless, the type of *B. acanthoneuron* has only two gametophytes and no sporophyte. Thus, we could not confirm the identity of this taxon.

Bryum clavatum (Schimp.) Müll.Hal., Syn. Musc. Frond. 1: 292. 1848.

Ochi (1980) mentioned it for Rio de Janeiro based on *Hagendorf s.n*. (L). However, it was not possible to locate the specimen at the L herbarium. This species' distribution is circum-subantarctic and extends to high altitudes of tropical South America (Argentina, Chile, Ecuador, Peru, Bolívia, Uruguay) and Juán Fernandes (Ochi 1980; 1982). Therefore, the Rio de Janeiro collection is doubtful and very disjunct from the species' remaining distribution range.

Bryum chryseum Mitt., J. Linn. Soc. Bot. 12: 304. 1869.

The species was recorded by Bordin & Yano (2009) for Rio Grande do Sul, but the correct identification is *B. dichotomum*. It is reported for Mexico, Guatemala, Bolivia and Chile (Ochi 1980).

Bryum cuspidatum (B.S.G.) Schimp., Syn. Musc. Frond. 2: 430. 1876.

It was recorded for Pará according to Lisboa & Yano (1987). However, in the identification label by A.J. Fife in 1982 (INPA64329) is written "*Bryum* aff. *cuspidatum*? (*Bryum* aff.) *erythrocarpum*? Without rhizoidal tubers. Antheridia not seen".

Bryum dimorphum (Müll.Hal.) Broth., Nat. Pflanzenfam. I(3): 574. 1903.

Yano (1981) recorded this species for Brazil, based on Müller (1901). However, this species is cited for Venezuela (Müller 1901; Pursell 1973).

Bryum gilliesii Hook., Botanical Miscellany 1: 3. 2. 1829.

The species was listed by Yano (1981) and Costa *et al*. (2011) for Brazil, with no specific locality. According to Ochi (1982), *B. gilliesii* occurs in Argentina, Chile, Uruguay and Falklands, but not in Brazil.

Bryum laevigatum Hook. f. & Wilson, London J. Bot. 3: 546. 1844.

Ochi (1980) mentioned the species for Brazil and considered *B. ypirangae* a synonym of *B. laevigatum*. Unfortunately, the type specimen of *B. ypirangae* lacks sporophytes (Dusén 4487 - PC0136878 image!, B300206364 image!). Due to this name being rarely applied since its description and to the incomplete type material, we could not confirm its identity. Visnadi (2005) observed the species for São Paulo (*Visnadi 4050* - SP354404!), but it is *B. riparioides* instead.

Bryum paradoxum Schwägr., Sp. Musc. Frond., Suppl. 3 1(1): 224: a. 1827.

This taxon was recorded for Rio de Janeiro by Ochi (1980), but we could not locate the examined material. *Bryum paradoxum* was also cited by Oliveira-e-Silva (1998) (*Oliveira-e-Silva 673*, SP322594!) and by Peralta *et al*. (2008) (*Silva 559* - SP322508!; *Estuqui s.n.*, SP208406!). However, the samples are *Rhodobryum beyrichianum* (Hornsch.) Paris. The specimen cited by Peralta *et al*. (2008) (*Vital 13464* - SP208406!) is *B. billarderii*, and the ones by Yano & Peralta (2008) (*Vital s.n*. - SP387377!, SP387378!) are *B. atenense*. Yano & Peralta (2004) also cited *B. paradoxum* based on *Windisch 1377* (SP148073!) and *Yano 12148* (SP227026!), but the correct identification is *B. huillense* and *Rhodobryum beyrichianum*, respectively. Yano (2010) mentioned several occurrences of *B. paradoxum* for Brazil, but many were sterile and/or misidentified. *Bryum paradoxum* is found in high latitudes and latitudes (Ochi 1980), which does not correspond to the localities cited by Yano (2010).

Bryum procerum Schimp. ex Besch., Mém Soc. Sci. Nat. Cherbourg 16: 199. 1872.

This name was transferred to *Rhodobryum* as *R. procerum* (Schimp. ex Besch.) Paris.

Bryum pseudocapillare Besch., Ann. Sci. Nat., Bot., sér. 6, 3(4): 205. 1876.

This species was mentioned by Yano & Peralta (2004) and Costa *et al*. (2005). The sample analyzed by Yano & Peralta

(2004) (*Yano 12108* - SP226992!) is *B. atenense*. Costa *et al*. (2005) do not mention a voucher. In Ochi's revision for the Neotropics (1980), the species was not recorded for Brazil.

Bryum pseudotriquetrum (Hedw.) G. Gaertn., B. Mey. & Scherb., Oekon. Fl. Wetterau 3(2): 102. 1802.

This species was cited for Brazil based on *Puiggari 649* (H) (Ochi 1980). However, in the same study this sample is also mentioned in the examined material of *B. pseudomarginatum* (which here is listed as a synonym of *B. densifolium*, a widespread species in Brazil). *Bryum pseudotriquetrum* was also recorded by Yano & Peralta (2008) (*Schäfer-Verwimp & Verwimp 10277* - SP386227!), but the correct identification is *B. pallescens*. *Bryum pseudotriquetrum* is typical of cold environments and has bipolar distribution (Ochyra *et al*. 2008).

Bryum radiculosum Brid., Muscol. Recent. Suppl. 3: 18–19. 1817.

Peralta *et al*. (2008) (*Vital 1156* - SP 89604!; *Vital 4994* - SP 125759!) and Yano & Peralta (2004) (*Yano 12122* - SP227004!) recorded the taxon for Brazil, but the correct names are *B. atenense*, *Brachymenium regnellii*, and *B. coronatum*, respectively. Ochi (1980) mentioned *B. radiculosum* to Santa Catarina based on *Ule 599* (H), but we could not find the specimen. *Bryum radiculosum* and *B. subapiculatum* are very similar (Ochi 1980), and the type material of *B. subapiculatum* is from Brazil and widespread in the country. Therefore, the specimen (*Ule 599*) could represent *B. subapiculatum*.

Bryum superpensum Müll.Hal., Bull. Herb. Boissier 6: 32-33. 1898.

This name is a synonym of *B. andicola* Hook. (Mohamed 1979).

Bryum torquatum Mohamed, Journal of Bryology 10: 454. f. 29, 33. 1979.

This taxon was listed by Costa & Peralta (2015) (*Glaziou 7176* - PC0709457 image!). However, it is *Bryum billarderii*.

Bryum turbinatum (Hedw.) Turner, Muscol. Hibern. Spic. 126. 1804.

It was recorded by Yano (1981) based on Hornschuch (1840), which mentioned the voucher of *Jameson s.n.* from Sebastianópolis. This sample could not be located in W and BM herbaria, which possess Jameson's collection. The species was also cited by Carmo & Peralta (2016) (*Carmo 404* - SP436608!), but its identification is *B. capillare*. According to Ochi (1982, 1985), the distribution of *B. turbinatum* is circumboreal and in high altitudes and latitudes of South America, sometimes extending to high altitudes in Africa. There is no record of *B. turbinatum* in Brazil except this made by Hornschuch (1840).

Imbribryum muehlenbeckii (Bruch & Schimp.) N. Pedersen, Bryol. Eur. 4: 163. pl. 381 (fasc. 32 Mon. Suppl. 1: 11. pl. 13). 1846.

Imbribryum muehlenbeckii is a segregated species of *Bryum* (Pedersen 2005), and was recorded by Yano & Peralta (2011b) (*Câmara 1945* - SP419659!), Yano (2011) (*Schäfer-Verwimp 9611* - SP461658!) and by Carmo & Peralta (2016) (Peralta 9284 -SP420853!). However, the correct names are *B. dichotomum* in Yano & Peralta (2011b) and *B. riparioides* for the last two.

Imbribryum muehlenbeckii has a holarctic and paleotropical distribution. It occurs in Greenland; Canada, USA, Mexico; Peru, Chile; West Europe; Asia (Caucasus); Australia; Atlantic Islands (Madeira) at higher latitudes or altitudes (Ochi 1982, 1994; Spence 2015). *Imbribryum muehlenbeckii* is somewhat similar to *B. riparioides*. However, they have different distributions.

Taxa of doubtful occurrence (10)

Bryum acuminatissimum (Müll.Hal.) Broth. in Engler & Prantl, Natürl. Pflanzenfam. 1(3): 597. 1904.

Yano (1981) cited this species for Brazil, but without locality. The name was published without a description, thus it is a *nom. nud*.

Bryum argenteum var. *crassirete* Broth., Ergebn. Bot. Exp. Südbras., Musci 296. 1924.

This variety was listed by Yano (1981), which was based on Brotherus's (1924) protologue. *Bryum argenteum* commonly shows phenotypic plasticity (Ochi 1994; Allen 2002). Brotherus (1924) described this variety as a robust plant. However, this characteristic was observed in some samples of *B. argenteum*. Furthermore, the type of this variety (*Schiffner, 1637* & *1773* - NY01163270!) lacks sporophyte, so we could not confirm this name.

Bryum brasiliense var. *minus* Herzog in Luisier, Brotéria, Ci. Nat. 10: 121. 1941.

This name was published without description, so it is an invalid name.

Bryum brevicoma Hampe., Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn, ser. 4, 1: 103. 1879.

The species was cited by Yano (1981) based on Hampe (1879), who described the species for Rio de Janeiro but did not include illustrations. The type specimen was not located. This name was listed in the excluded species section by Costa *et al*. (2011) due to the lack of information.

Bryum conoideo-operculatum Warnst., Hedwigia 57: 97. 31. 1915.

Yano (1981) cited the species for Rio Grande do Sul (Warnstorf 1916) but did not mention a voucher, and the illustration in Warnstorf does not allow us to recognize the species. Costa *et al*. (2011) listed the species in the excluded taxa section.

Bryum crispifolium Müll.Hal., Gen. Musc. Frond.: 211. 1901.

This is an invalid name because the diagnosis does not distinguish this species from other species (*nom. nud*.).

Bryum duplicatum Broth., Bih. Kongl. Svenska Vetensk.-Akad. Handl. 26, Afd. 3(7): 29. 1900.

Ochi (1980) cited the species for Brazil, based only on the type (*Lindmann 401*, R000081177 image!), which lacks sporophytes. Yano & Peralta (2011a) also mentioned it for

Minas Gerais (*Yano 21786* - SP274704!), but the correct name is *B. densifolium*.

*Bryum graciliseta*um Hornsch., Flora Bras. 1(2): 44. 1840.

We could not find the type specimen for this species.

Bryum illecebraria Müll.Hal., Gen. Musc. Frond. 215. 1900.

The name was cited for Brazil by Yano (1981) based on the protologue of Müll.Hal. (1900). However, the protologue lacks both a voucher and a diagnosis. The name is insufficiently known (Crosby *et al*. 1999) and is considered a *nom. nud*.

Bryum multiflorum Müll.Hal., Syn. Musc. Frond. 1: 339. 1848.

It was cited by Yano (1981) and Costa *et al*. (2005). The last study does not mention the voucher. It was not possible to find the type specimen of *B. multiflorum*, and information on this taxon is scarce. The species is listed by Costa *et al*. (2011) in the excluded taxa section.

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