



## *Schlotheimia spinomitria* (Orthotrichaceae, Subg. *Schlotheimia*), a new species from Brazilian Cerrado

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*Schlotheimia spinomitria* (Orthotrichaceae, subg. *Schlotheimia*), is proposed, described and illustrated as a new species based on collections from central Brazil. It is characterized by its distinctive calyptra ornamented with multicelled foliose spines. *S. spinomitria* is currently known only from three specimens from the Cerrado (Savana) area, and could be considered rare, vulnerable and potentially threatened. A key is provided to distinguish it from the other Brazilian species with ornamented calyptra.

Key words: Cladocarpous, Orthotrichales, Brazilian savanna, Calyptra

*Schlotheimia* Brid. (1812: 16–22), was described by Samuel Élisée von Bridel in 1812 in the *Muscologia Recentiorum Supplementum*; the name is in honor of the German palaeobotanist Ernst Friedrich von Schlotheim (Vitt 1989).

*Schlotheimia* comprises approximately 121 currently accepted names (Crosby *et al.* 1999), with 56 cited for the Neotropics (Gradstein *et al.* 2001) and 34 for Brazil (Atwood 2009; Yano 2011). The Brazilian moss checklist (Costa *et al.* 2011) includes 30 taxa of *Schlotheimia*, however, only 13 names were included in checklist; and 17 names were indicated as poorly known, thus highlighting these names as most in need of urgent revision.

*Schlotheimia* is distinguished from other genera in the Orthotrichaceae by its leaves with smooth laminal cells, of which the basal cells are elongate and distinctly porose, the calyptra which is smooth (rarely roughed), campanulate and with a lobed base, and the peristome teeth which are long linear with a median line (Gradstein *et al.* 2001).

The plants form dense mats on tree trunks or more rarely on rocks, are dark green in color, sometimes black or brown in the creeping stem. The primary stem is creeping with growth continuous, the secondary stems are short and erect. The occurrence of this genus is always associated with xeromorphic habitats in exposed areas with direct sunlight, and it is found from sea level to 2,600 meters a.s.l. (Vitt 1989; Gradstein *et al.* 2001; Atwood 2009).

*Schlotheimia* comprises two subgenera: 1) the subgenus *Schlotheimia* Brid., which is characterized by the exerted, large capsules with long campanulate calyptrae, and 2) the subgenus *Stegotheca* (Mitt.) Broth. (1903: 495), which is distinguished by its immersed capsules with small conic calyptrae (Atwood 2009).

*Schlotheimia* remains taxonomically unresolved in South America with a large number of superfluous names. Further monographic work is needed to reveal the true diversity of this genus in the region. The first bryological account compiling species of *Schlotheimia* known from Brazil was published by Mitten (1869) and included 30 species, though most of them have since been reduced to synonymy. Sehnem's account of Brazilian mosses (Sehnem, 1978) listed 13 species of the *Stegotheca* subgenus (including a new species) and 24 of the *Schlotheimia* subgenus. This work is one of the most important treatments of the Brazilian mosses but has several taxonomic problems as the species treated are no longer recognized as distinct and the keys and descriptions are of limited use.

The floristic works of Bartram (1949), Florschütz (1964), Sharp *et al.* (1994), Duarte Bello (1997) and Allen (2002) which cover other Neotropical areas include only four species also known from Brazil but are useful for identification of specimens.

More recently, the taxonomic revision of the subgenus *Stegotheca* (Atwood 2009) has reduced 15 names to two species and one variety. After analyzing the literature and types of this genus for Brazil we reached 34 accepted names and only two of these have trichomes ornamenting the calyptra; *Schlotheimia trichomitria* and *Schlotheimia compacta* Müll. Hal. (1849: 763) which are here recognized as synonyms. Specimens of *Schlotheimia rugifolia* (Hook.) Schwägr., which is widespread in Central and South America, described by Allen (2002), have papillose apex, and we observed specimens occasionally papillose and more frequent smooth.

We have found that the diagnostic description of the genus *Schlotheimia* (as showed by Gradstein *et al.* (2001) and Goffinet & Vitt (1998)) needs to be broadened because these authors describe the genus with smooth, or rarely roughend calyptrae and only the subgenus *Stegotheca* (Atwood 2009) agrees with this. The Brazilian species of the subgenus *Schlotheimia* Brid. have smooth, roughend or hairy calyptra and the new species described here has a spinose calyptra. This feature is conflicting also with the circumscription of the genus *Schlotheimia* in the phylogeny of the Orthotrichales of Goffinet *et al.* (1998) where the genus is included in the subfamily Macromitrioideae based on the plesiomorphic characteristics such as acrocarpy and the smooth and campanulate calyptrae, however this result is unclear because this phylogeny includes sequences of the species *Schlotheimia trichomitria* Schwägr. that is clearly recognized by its hairy calyptra.

The calyptra ornamentation of *Schlotheimia* is always described as smooth (Goffinet & Vitt 1998, Gradstein *et al.* 2001) or rarely roughend, and in some treatments the presence of hairs on the calyptra is used to differentiate from other genera. However, the ornamentation of calyptrae in *Schlotheimia*, in fact, includes most forms found in the family Orthotrichaceae (smooth, rough, hairy). The only characteristic definitely not found in *Schlotheimia* is the plicate calyptra commonly shown in species of *Macromitrium* Brid. (1819: 132) and *Groutiella* Steere (1950: 145). Consequently, *Schlotheimia* is best distinguished at the generic level by the diagnostic features of the four lobed calyptra base combined with the elongate and prorate cells throughout the leaf base. The four lobed calyptrae is shared between *Schlotheimia* and *Cardotiella* Vitt (1981: 101) but the latter has strongly differentiated basal leaf areolation with inflated and tuberculate cells (Vitt 1981).

*Schlotheimia* has a Gondwanan distribution, widespread in the southern hemisphere from the tropics to south temperate zones (Eddy 1996), with recent expansions to the northern hemisphere (Grout 1946). Species outside of America have uniformly smooth calyptra and species are treated regionally for South Africa (Van Rooy & Van Wyk 1992, Magill & Van Rooy 1998), India (Gangulee 1976), China (Koponen & Enroth 1992, Guo *et al.* 2007), Malesia (Eddy 1996), Papua New Guinea (Vitt *et al.* 1993) and Australia (Vitt 1989, Ramsay *et al.* 2006).

Southeastern Brazil is cited as a center of diversity for the genus (Vitt 1989). However, Churchill & Linares (1995) and Gradstein *et al.* (2001) discuss the difficulty of identifying species of *Schlotheimia* in South America because of the existence of many names which are often known only from the type specimen and original description. In response to this urgent need for critical revision of the genus, we have decided to revise the type and herbaria specimens of *Schlotheimia* for Brazil.

We examined 23 type specimens and 1,400 herbaria specimens from the following herbaria: B, BM, G, H, ICN, MICH, NY, PC, PE, R, SP, SJRP, R and TUR. We recognize nine species to Brazil (data in preparation) and the one new species proposed here demonstrates a unique morphology of the calyptra for the genus and family.

## Taxonomy

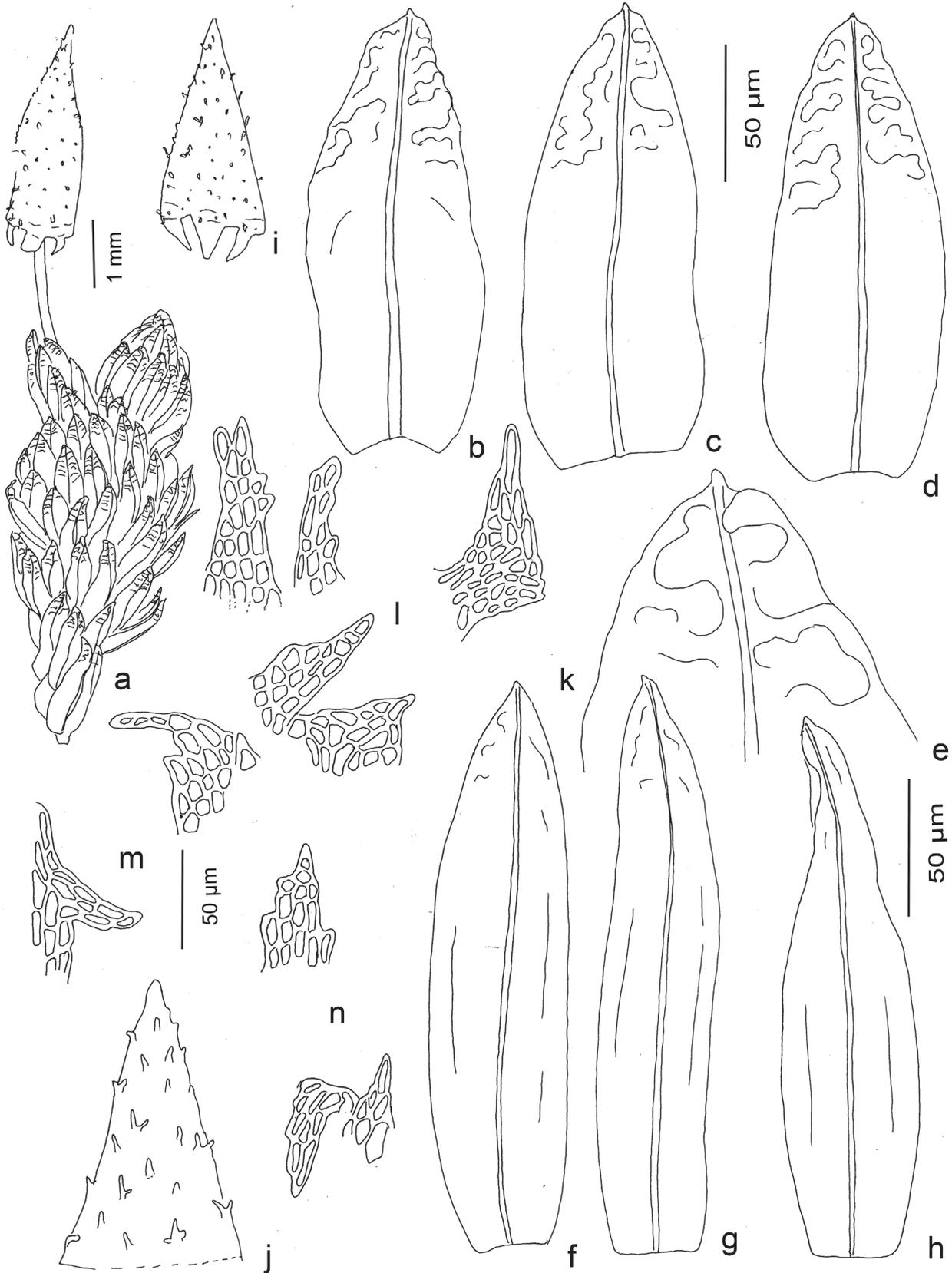
### Key to the species with ornamented calyptra in Brazil

- |    |   |                                  |
|----|---|----------------------------------|
| 1. | Calyptra with trichomes uniseriate, filamentous ..... | <i>Schlotheimia trichomitria</i> |
| 1. | Calyptra with spines multicellular, foliose .....     | <i>Schlotheimia spinomitria</i>  |

### *Schlotheimia spinomitria* D.F. Peralta & R. Ristow, *sp. nov.* (Fig. 1)

Type:—Brazil, São Paulo, São José do Rio Preto, pasto (29°49'11"S–49°22'46"W), 14 April 2004, Peralta, D.F. & Jungbluth, P. 2367 (holotype SP!).

Plants medium sized, forming dense mats, dark green, occasionally blackish or brown to reddish at base. Stems creeping, often densely tomentose in the contact with the substrate by the abundance of rhizoids, branches short and erect; in cross-section as in the genus with outer 2–3 rows of cells small, thick-walled, inner cells large, firm-walled, central strand absent; rhizoids smooth. Stem leaves spaced by tomentum, oblong-lanceolate, plane, 1–1.2 mm long, apiculate. Branch leaves appressed and often spirally coiled about stem when dry, crispate at distal portion, wide-spreading when wet, ovate-oblong, 1.5–2.0 mm long, rugose at distal portion, apex with a small apiculum, base often with rhizoids; margins plane, entire; costa single, strong, channeled, short excurrent; median cells isodiametric, 7–8 µm wide, 6–7 µm long, rhombid to oblong-rhombic, thick-walled; basal cells elongate, linear, thick-walled and porose, tubercula lacking; basal margin undifferentiated. Perichaetia terminal on short lateral branches, perichaetial leaves lanceolate, 2.0–2.3 mm long, weak rugose at distal portion, apex with a small apiculum, base often with rhizoids; margins plane, entire; costa single, strong, short excurrent; median cells



**FIGURE 1.** *Schlotheimia spinomitria*. A) Plants with capsule. B–D) Vegetative leaves. E) Apex of vegetative leaf. F–H) Perichaetial leaves. I) Calyptra. J) detail of calyptra apex. K–N) Ornamentation of calyptra (from the holotype, drawing by DFP).

fusiform, thick-walled; basal cells elongate, linear, thick-walled and porose, tubercula lacking; basal margin undifferentiated. Seta elongate, 2–3 mm long, stout, smooth. Capsule exserted, erect, ovoid-cylindrical, 1.5–1.7 mm long; exothecial cells irregularly oblong-rectangular, thick-walled; stomata at urn base, superficial. Operculum long-rostrate. Peristome double, exostome reflexed when dry, papillose; endostome segments 16, shorter than exostome, or reduced. Calyptra campanulate, spinose, spines sometimes foliose, base often four lobed. Spores spherical, 12(–14)–18(–20)  $\mu\text{m}$ , sharply papillose.

**Distribution and ecology:**—Epiphyte on isolated trees in open Savana. These environments are rapidly decreasing because this vegetation is considered low diversity and are the first areas to be destroyed by livestock and farmers. As such, even when taking into account the large geographical distance between the specimens examined, we believe that this species should be considered threatened.

Etymology:—The epithet *spinose* refers to the calyptra ornamentation.

**Discussion:**—*Schlotheimia spinomitria* belongs to the subgenus *Schlotheimia* by its large, mitrate and lobate calyptra. There are only two species described with hairy calyptra in this subgenus; *Schlotheimia trichomitria* and *Schlotheimia compacta* Müll. Hal. both from South America. The type specimens have been examined and both have long uniseriate hairs on the calyptra and here *S. compacta* is reduced to the synonym of *S. trichomitria*. These species are unique with the calyptra ornamentation, but differ from the new species described here because their trichomes are very long, sometimes as long as the calyptra length, and uniseriate, whereas *S. spinomitria* has the spines short and multicellular. These species are differentiated according to the key provided.

We checked the description of all species currently accepted in the genus and this calyptra feature is unique, even to the family. Even though the epithet of the species *S. spinulosa* Broth. (1906: 273) (described from Peru) indicates “spines” the original description indicate the calyptra as “spinuloso-aspera”, probably rugose, and the photograph of type material BM000873395 (Accessed via the JSTOR online type image depository—<http://plants.jstor.org/stable/viewer/10.5555/al.ap.specimen.bm000873395>) does not have trichomes visible on the calyptra.

After analysing near 1,400 specimens of *Schlotheimia* from Brazil and nearby countries from the follow herbarium of B, BM, H, ICN, NY, PC, PE, R, SJRP, SP and TUR. We found this new species represented only by three collections in the Brazilian savanna (cerrado), where it occurs on isolated trees on open places. It was not encountered among the many Brazilian collections from all regions and, apparently it does not survive on disturbed places as observed in several samples from these places, this way is therefore considered rare, and vulnerable and potentially threatened.

**Additional specimens examined.** Brazil. Bahia state: Pirituba, 3 April 1976, *Vital, D.M. 6013* (SP!); Goiás state, Luziânia, 17 May 1976, *Vital, D.M. 6274* (SP!); idem, Pirenópolis, 18 March 2006, *Yano, O. & Sousa, M.A.R. 28619* (SP!).

*Schlotheimia trichomitria* Schwägr., Spec. Musc. Frond. Suppl. 2(2): 55. 1826. Type:—[Uruguay] Brazil, Brasilia, Monte Video (Uruguay), *F. Sellow s.n.* (isotype NY1244105!).

= *Schlotheimia compacta* Müll. Hal., Syn. Musc. Frond. 1: 763. 1849. Type:—[Brazil] Brasilia, Pajol, *G. Gardner 67* (isotype NY02031977!), *syn. nov.*

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