


Sematophyllum rheophyticum (Bryopsida, Sematophyllaceae), a new rheophytic species from Rwanda

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Background: *Sematophyllum* is a pantropical genus of approximately 170 species. The genus has never been revised on a global scale and is poorly known in many areas of the world. This is perhaps especially true in Africa where 60 accepted species are recorded, many seemingly endemic to the eastern and central tropical areas. Further taxonomic work will enable better understanding of the genus, its biogeography and regional patterns of plant diversity; help guide conservation efforts; and facilitate a broader understanding of the evolution of the Afro-tropical flora.

Objectives: The objective of this study is to describe a new species of *Sematophyllum* from Rwanda, part of the mega-diverse Albertine Rift system.

Methods: Light microscopy was used to compare anatomical and morphological details of the putative new species with specimens of other members of the genus with which it could potentially be conspecific.

Results: *Sematophyllum rheophyticum* W.R. Buck & Hedd. was described as new and is currently known only from the type locality at Gisakura, Nyungwe National Park, Rwanda. It is distinguishable from all congeners by a unique combination of characters including the concave, abruptly acuminate leaves, the alar areolation and the rheophytic habitat.

Conclusion: *Sematophyllum rrdicum* is a new species, defined by a combination of several anatomical characters, known currently only from the type locality. Furthermore, it is one of only a few species in the genus that occurs in rheophytic habitats. Its phylogenetic relationships are obscure and will probably need to be evaluated with molecular evidence.

Introduction

Sematophyllum is a large, predominantly pantropical, genus of ca. 170 currently accepted species (Crosby *et al.* 2000). Among pleurocarpous mosses, the genus is defined largely by having a perfect peristome, collenchymatous exothecial cells, an obliquely rostrate operculum, leaves with smooth, rhomboidal to linear cells, strongly differentiated alar cells and the costa short and double to lacking. Apart from these characters, a great range of morphology has been accommodated within the genus. It is badly in need of revision at a global scale and, given the morphological heterogeneity accommodated within it, its monophyly needs to be tested.

In his checklist of African mosses, O'Shea (2006) accepted 59 species of the genus for sub-Saharan Africa. Recently, Câmara and Van Rooy (2014) described one additional species from South Africa, bringing the current total for the continent to 60. In Africa, much of the diversity is located in the eastern and central tropical areas, where 27 of the species are recorded, several seemingly endemic to the region (O'Shea 2006).

Here, we describe a distinctive new species of *Sematophyllum* from the central African country of Rwanda, part of the mega-diverse Albertine Rift system. The collections were made as part of a course in bryophyte biology funded by UNESCO, under their training programme in taxonomy and bioinformatics in support of a Centre of Excellence in Biodiversity and Natural Resources Management in Rwanda. As noted by Hedderson *et al.* (2014), the collecting site has been visited previously by bryologists and, along with the numerous new country records reported in that study, the new species suggests that Rwanda remains significantly under-recorded for bryophytes.

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Research method and design

Material was collected in the field into paper packets and air dried as rapidly as possible under ambient conditions (i.e. without an artificial heating source). The single specimen of the new species was compared with material of all known species with which it could conceivably be conspecific – that is, all species with concave apices and short apical laminal cells. Material, including types, was studied from extensive holdings at BOL, NY, and PC. Specimens were examined under both dissecting and compound microscopes, and measurements were made using an ocular micrometer.

Taxonomic treatment

Sematophyllum rheophyticum W.R. Buck & Hedd., n.sp.

Type: RWANDA. Nyungwe National Park, Gisakura, trail between Nyungwe Forest Lodge and waterfall, at the waterfall, 1845 m, 2°26'51.1"S, 29°06'52.8"E; pristine mountain rain forest above river, and schistose cliffs around falls; on rocks in swift stream. 03 Oct. 2012, Hedderson 18129 (BOL, holo; NY, iso.).

Description

Plants medium-sized, in loose, golden-green mats, attached to rocks in fast-flowing stream. *Stems* creeping, to ca. 1.5 cm long, in section with 2–3(–4) rows of small, thick-walled, dark-red cells, surrounding abruptly larger, thin- to firm-walled cells, central strand none; pseudoparaphyllia none; axillary hairs with a single brown short-rectangular basal cell and 3(–4) hyaline elongate apical cells. *Stem and branch leaves* similar, loosely erect wet or dry, somewhat homomallous, ovate, 1.1–1.4 × 0.4 mm – 0.7 mm, abruptly short-acuminate to ± cuspidate, concave; margins entire throughout, mostly plane but sometimes broadly incurved; costa short and double to absent, when present usually dark orange; laminal cells long-hexagonal at midleaf, (30–)35–43(–54) × 5 μm – 6 μm, thin- to firm-walled, smooth, becoming shorter (ca. 2:1) in the acumen, becoming longer, thicker walled and porose towards the insertion; alar cells strongly differentiated, dark orange, mostly in 3(–4) rows, enlarged, ± inflated, thick-walled, not reaching costa but dark-orange colouration extending all across the insertion. *Autoicous*. *Perigonial* bracts ca. 0.33 mm long, ovate, gradually acute; costa none; areolation irregular, with cells 2–6:1, thick-walled, somewhat porose. *Perichaetial* leaves lanceolate, gradually short-acuminate, 1.1–1.4 × 0.3 mm – 0.4 mm; margins entire; costa none; laminal cells linear, thick-walled; alar cells not differentiated. *Setae* dark red, ca. 11 mm – 16 mm long, smooth; capsules inclined, symmetric, short-cylindric, ca. 1 mm long, not constricted below mouth when dry; exothecial cells ± isodiametric, somewhat but not strongly collenchymatous, smaller and darker in ca. 3 rows at mouth; stomata at base of capsule, round-pored; operculum obliquely rostrate, ca. 0.4 mm long; annulus not seen; exostome teeth on front surface

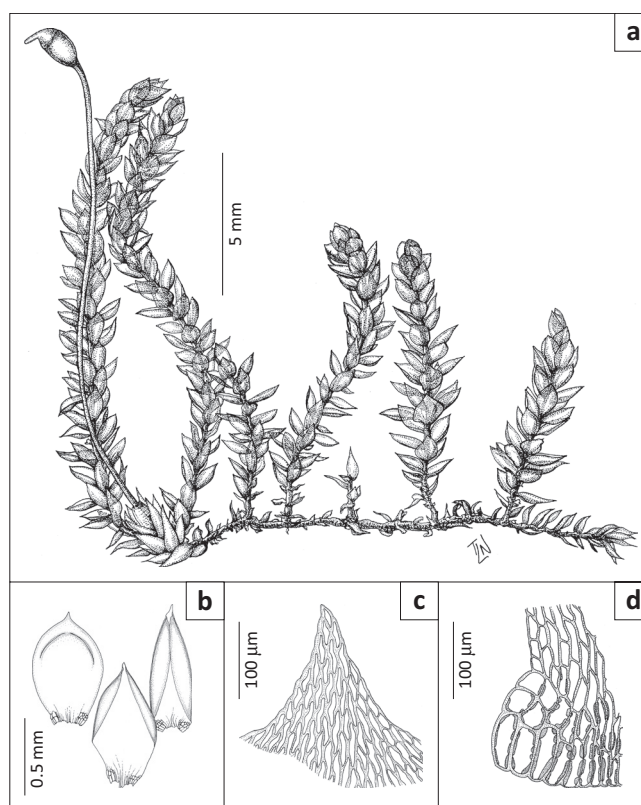
cross-striolate below, coarsely papillose above, not furrowed, at back strongly trabeculate, finely papillose; endostome finely papillose throughout, basal membrane high, segments keeled, not perforate, about as long as the teeth, cilia single, stout, almost as long as the segments, nodose. *Spores* spherical, 16 μm – 19 μm in diameter, very finely papillose, almost smooth. *Calyptrae* cucullate, naked, smooth (Figure 1).

Etymology

The species epithet refers to the habitat in which the new species grows, that is, attached to rocks, and often submerged, in swift mountain streams.

Ecology and distribution

Sematophyllum rheophyticum is currently known only from the type locality in Nyungwe National Park, where it occurred on highly mineralised schistose rock in a swift mountain stream below a waterfall. Other species with which it was intimately associated include the rare intercontinental disjunct *Bryocrumia vivicolor* (Broth & Dixon) W.R. Buck, and the equally rare *Scopelophila ligulata* (Spruce) Spruce, a species that is typically associated with mineralised rocks, often containing heavy metals (Hedderson *et al.* 2014). Until more collections are available, it is impossible to ascertain how typical the known locality is, but it should be sought in other similar localities in the eastern and central African montane tropics.



Source: Drawings by Tracey L. Nowell, newly produced for this article

FIGURE 1: *Sematophyllum rheophyticum*, (a) habit, (b) leaves, (c) cells at leaf apex, (d) alar and basal leaf cells. All from Holotype.

Discussion

The new species of *Sematophyllum* is characterised by ovate, abruptly short-acuminate, concave leaves, with extensively developed, dark-orange alar cells in about three rows, but not reaching the costa. Furthermore, the habitat of rocks in a fast-flowing stream is distinctive. Among African species of the genus, the rheophytic habit is rare and, as far as we are aware, the only other African species to exhibit it is the recently described *Sematophyllum magillianum* Câmara & Van Rooy of South Africa (Câmara & Van Rooy 2014). However that species is much larger and differs in many features including leaf shape and the nature of the alar cells.

Sematophyllum rheophyticum may be most closely related to *Sematophyllum fulvifolium* Mitt., and that is a name that Potier de la Varde (1927) used for material from nearby Oubangui (Central African Republic), even though the type of that name is from Rodrigues, in the Indian Ocean. Examination of the material identified by Potier de la Varde indicates that almost all are correctly named. In addition, we studied the holotype of *S. fulvifolium* (Rodrigues, Balfour, NY). That species has narrower, more cochleariform leaves that are more gradually acuminate; the alar cells are differentiated in only a single row; and the capsules are completely erect. Nevertheless, Potier de la Varde's (1927) description of the plants that he had in hand more closely resembles *S. rheophyticum* than *S. fulvifolium*, and his specimen came from 'sous bois près rivière Bayedou', a very similar habitat to *S. rheophyticum*. There is no habitat description associated with the type of *S. fulvifolium*. The morphology of the specimens, though, leaves no doubt that they are a good match for *S. fulvifolium* and not at all like our *S. rheophyticum*.

In the same publication, Potier de la Varde (1927) described *S. fulvifolium* var. *patulifolium*. It was characterised by spreading leaves that are less acuminate, apparently as well by an anisoporous condition (spores ranging from 12 µm to 21 µm). The type material (Oubangui [Central African Republic], rivière Beu, village de Torogwandé, Tisserant, PC) is scarcely different from typical *S. fulvifolium* and is not our new species.

Conclusion

We conclude that the *Sematophyllum* populations at Gisakura, Rwanda, represent a new species, known currently only from

the type locality, for which we propose the name *Sematophyllum rheophyticum*. It is defined by a combination of several morphological and anatomical characters, including leaf shape and alar areolation. Furthermore, it is one of only a few species in the genus that occurs in rheophytic habitats. Its phylogenetic relationships are obscure and probably will need to be evaluated with molecular evidence.

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Competing interests

The authors declare that they have no financial or personal relationships which may have inappropriately influenced them in writing this article.

Authors' contributions

T.A.J.H. discovered the new species, tentatively placing it in *Sematophyllum*, and contributed to writing the paper, particularly segments of the Introduction and Discussion. W.R.B. confirmed the generic placement, recognised its status as a new species, undertook most of the comparative work, wrote the first draft of the description and contributed to writing the other portions of the article.

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