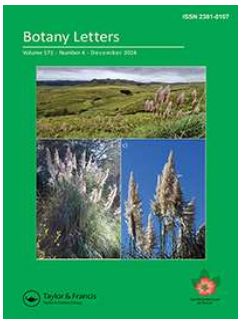

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Rhynchospora psammophila (Cyperaceae), a new species from the northern Amazonian savannas

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ABSTRACT

During a taxonomic revision of the neotropical species of *Rhynchospora* sect. *Pauciflorae*, a new species was found in the savannas of the southern portions of the Guiana Shield in Venezuela, and Brazil, and is described here. *Rhynchospora psammophila* occurs on periodically flooded white-sand savannas, and differs from the other species of *R.* sect. *Pauciflorae* mainly due to the thick roots, long spikelets, and long nutlets. Descriptions, taxonomic comments, illustrations, preliminary conservation status assessments, habitat, and a distribution map are provided.

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KEYWORDS
Rhynchosporae; Guiana Shield; sedges; white-sand savannas; taxonomy

Introduction

Rhynchospora Vahl is very diverse in tropical America (Strong 2006) and comprises about 400 species worldwide (Larridon et al. 2021; Silva Filho et al. 2021). In the Americas, it is particularly diverse with high levels of endemism in tropical and subtropical savannas (Buddenhagen et al. 2017) and is one of the most diverse herbaceous genera in the open white-sand Amazonian savannas (Grande et al. 2023).

Rhynchospora sect. *Pauciflorae* (currently comprising 24 species) is distributed in the Americas, Asia and Oceania (Kükenthal 1949; Koyama 1972; Luceño 1997; Schneider et al. 2019), and has never been revised since its creation by Kükenthal (1949). As part of a taxonomic revision of the neotropical species of the section (Alves et al. in prep.), a new species was discovered and is described here.

Here we describe, and illustrate the new species, also present distribution map, habitat, preliminary assessments of the conservation status, and provide comparisons with closer morphological species.

Material and methods

Specimens of *Rhynchospora* in the following herbaria BHCB, IAN, INPA, IPA, JPB, MBM, MFS, MG, NY, PEUFR, R, RB, SP, SPF, UFP and US were analyzed (acronyms according to Thiers 2024 - updated continuously). Morphological descriptions and the hand-drawn illustration were based on dried specimens, using a stereomicroscope. The general terminology followed Hickey and King (2000), Harris and Harris (2001), and Wilhelm and Hericha (2017). Specific Cyperaceae terminology was based on Simpson (2006), and inflorescence morphology followed Reutemann et al. (2012).

Digital images were taken using a stereomicroscope equipped with a digital camera, and the Leica Application Suite package. The SEM images of the nutlets were taken by means of scanning electron microscopy with a field-emission electron gun at the Electron Microscopy Laboratory (LME), in Museu Paraense Emílio Goeldi (MPEG). Samples were coated using Au for 2 min and 30 s, at a thickness of 10 to 15 nm. Images were generated by secondary electron detection, with 5 kV and a working distance between 15 and 25 mm of voltage acceleration (Alves et al. 2023).

The geographic distribution and habitat data were obtained from the specimen labels. Conservation status assessment was performed following IUCN Red List Categories and Criteria v.14 (IUCN 2022). The extent of occurrence (EOO) and the area of occupancy (AOO) of the species (cell width 2 by 2 km grid) were estimated using the GeoCAT- Geospatial Conservation Assessment Tool (Bachman et al. 2011).

Taxonomic treatment

Rhynchospora psammophila K. Alves, W. Thomas & A. Gil, *sp. nov.* (Figures 1–6)

Diagnosis: *Rhynchospora psammophila* is similar to *Rhynchospora subplumosa* C.B.Clarke and *Rhynchospora trichochaeta* C.B.Clarke, but differs by its 5 perianth bristles per bisexual flower, long nutlets with 4.2–4.4 mm, with lobed margins, and long style base with 1.9–2.2 mm.

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Figure 1. Holotype of *Rhynchospora psammophila* [Pastore M. & Santos M. S. 1313 (MG)]. Courtesy of the MG herbarium.

Type: Brazil. Roraima: Caracaraí, Parque Nacional do Viruá, grade do PPBio, parcela L04, pequena campinarana aberta, 1°27'32.82"N 61°1'37.86"W, 58 m, 15 October 2020, *Pastore M. & Santos M. S. 1313* (holotype MG245704, isotypes: RB, IAN).

Etymology: The epithet "*psammophila*" is related to the habitat where the species occur, on the white sand savannas. It is a combination derived from the Greek words "psammos" which means "sand", and "philo", affection.

Description

Herbs, cespitose, perennial, 24–75 cm tall; base rhizomatous, not bulb-like, rigid, usually fibrous, sometimes covered by old sheaths, yellowish to ochraceous; rhizomes horizontally creeping, squamose, conspicuous, 1.7–3.5 mm wide, often knotty, roots 0.5–2.1 mm wide. Stems 21–73 × 0.07–0.1 cm, triangular to subtriangular in cross section, glabrous to ciliate on the angles toward the apex, angles unarmed, greenish to ochraceous. Leaves mostly basal, the lowest sometimes burned off, 1–3 cauline per stem, sheaths 1.5–7.5 cm long, membranous to subcoriaceous, glabrous to puberulent, the inner band membranous, greenish to ochraceous; blades 8–29 × 0.1–0.3 cm, linear, with a third of or exceeding the height of the stems at maturity, carinate to conduplicate, cartaceous to subcoriaceous, rigid, greenish to ochraceous; margins antrorsely scabrous towards the apex, ciliate to densely ciliate, the midvein unarmed to antrorsely scabrous toward the apex, glabrous to ciliate abaxially, adaxial surface glabrous, abaxial surface glabrous to pilose, the apex acute to obtuse. Involucral bracts 3–4, 3.5–20 × 0.6–1.4 mm, spirally imbricated, linear-lanceoloid, ochraceous, papyraceous to chartaceous, foliaceous, the midvein glabrous adaxially, abaxially ciliate toward the apex, unarmed, the margins ciliate proximally to medially, the marginal trichomes 0.3–1.2 mm long, scabrous, the apex obtuse to broadly acute, shorter than to exceeding the inflorescences. Inflorescence capituliform, hemispherical, 0.8–1.5 × 0.7–2 cm, comprising 8–16 spikelets, each spikelet subtended by a bract and a prophyll;

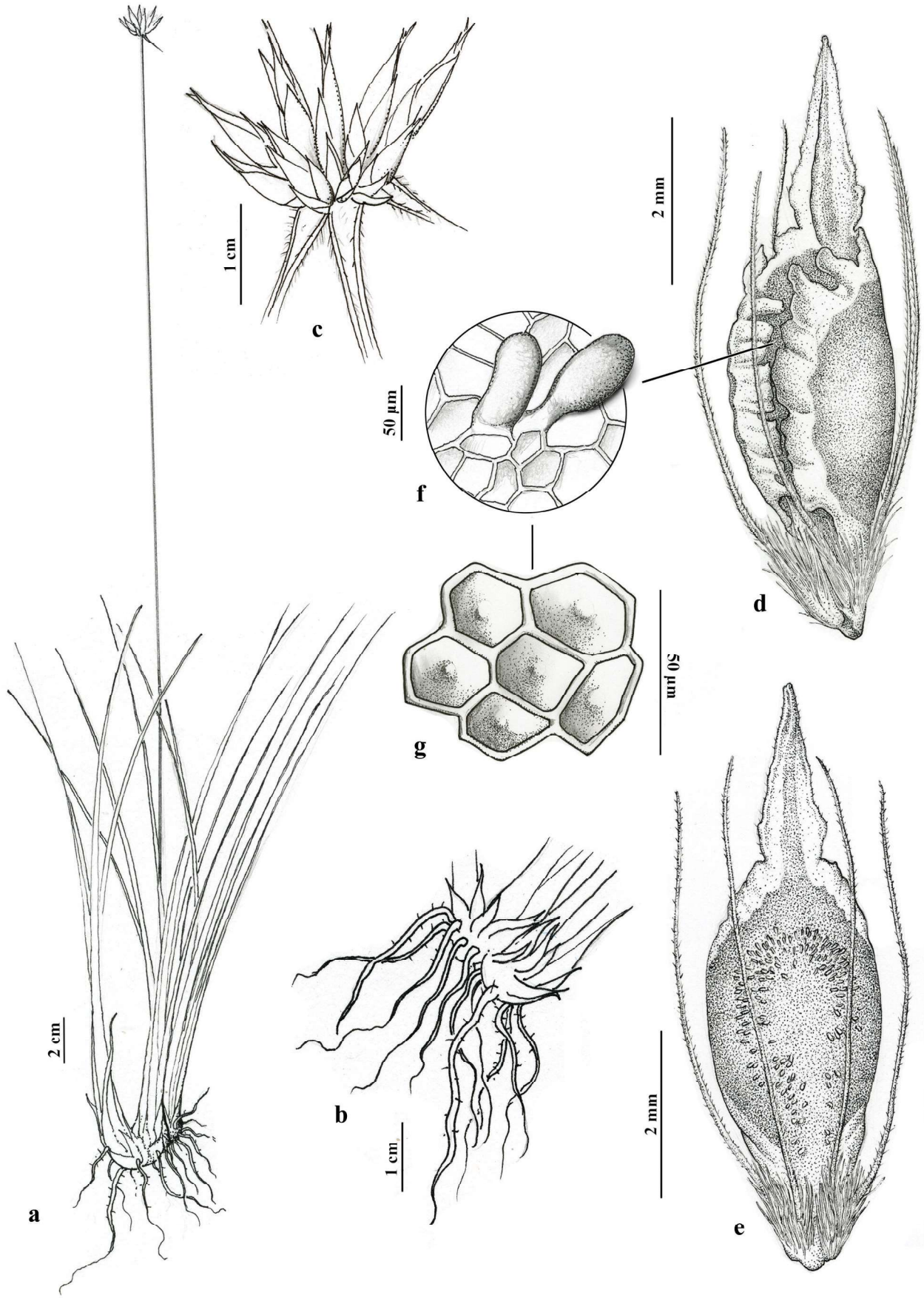

Figure 2. Illustration of *Rhynchospora psammophila* K. Alves, W. Thomas & A. Gil. a. Plant habit. b. Base. c. Inflorescence. d. Nutlet, concave side. e. Nutlet, convex side. f. Nutlet, surface of the concave side. g. Silica bodies on the nutlet surface. (A, B, C, G. Drawn by E. Rocha; C, D. Drawn by J. Silveira).

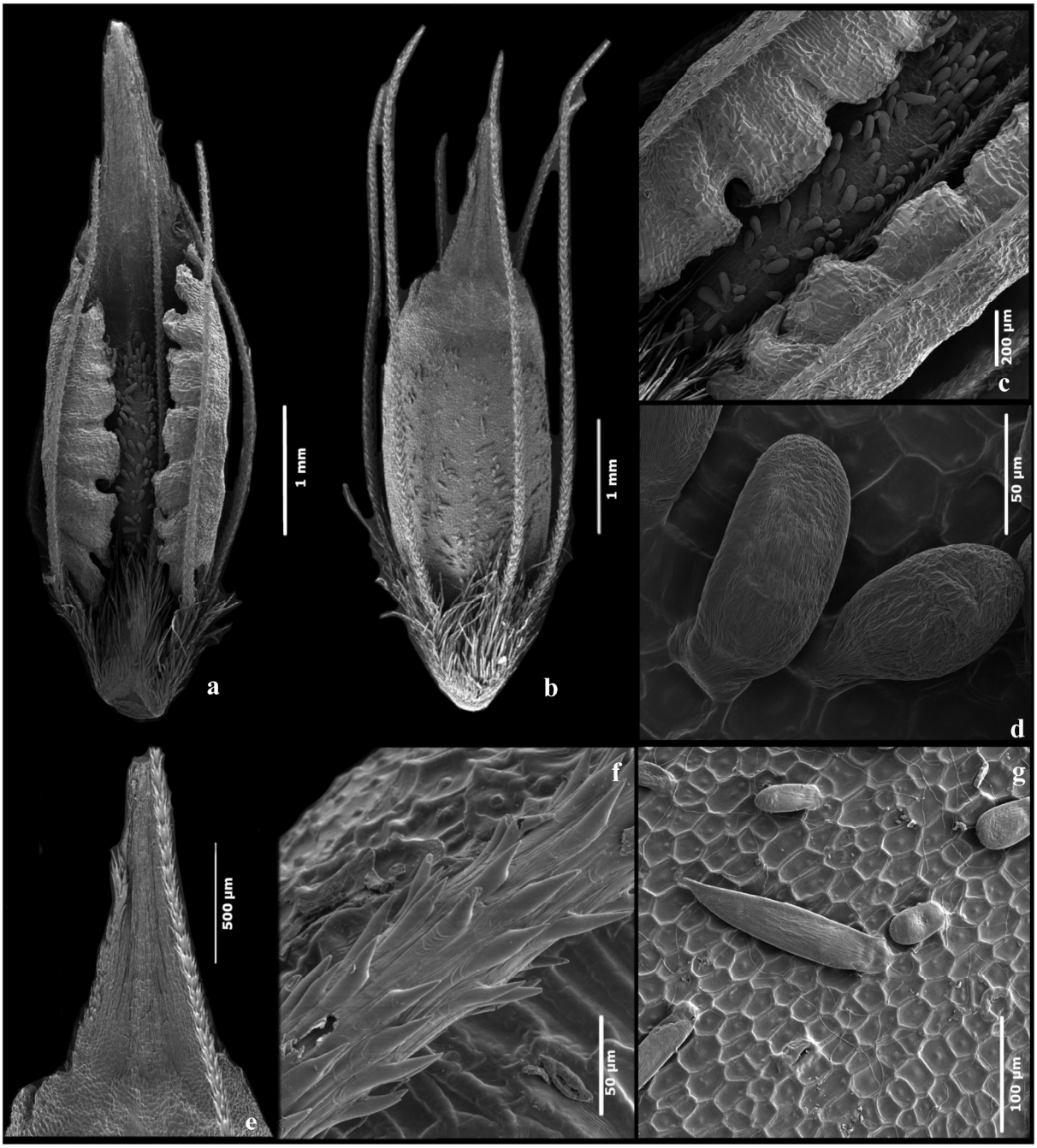

Figure 3. *Rhynchospora psammophila. SEM Images*. a – concave side of the nutlet, with bristles; b – convex side of the nutlet with bristles; c – concave surface of the nutlet showing lobed margins and papillae; d – papillae and epidermal cells; e – detail of the style base; f- Detail of the perigonial bristle; g. Convex surface papillae and epidermal cell details. [illustrations from Pastore M. & Santos M. S. 1313 (MG)].

spikelet bract 2.1–4.4 × 0.6–0.9 mm, glumaceous, ochraceous, the margins ciliate (medially to apically), apex narrowly acuminate; spikelet prophyll 1–1.5 × 1–1.3 mm, glumaceous, with 2-keels, ciliolate medially toward the apex, apex obtuse to biacuminate, margins glabrous; spikelets 7–9.3 × 1.2–2.5 mm, narrowly lanceoloid; glumes 11–12 per spikelet; basal sterile glumes 4, 1.2–3.4 × 1–3 mm, ovate to lanceolate, straw-coloured to dull brownish yellow; distal fertile glumes 7–8, 5.3–7.7 × 1.5–3.2 mm, lanceoloid to narrowly lanceoloid, ochaceous, vinaceous close to the margins, the margins hyaline, the surface semiglossy, glabrous, chartaceous, the apex acute to obtuse, the two lowermost ones subtending the bisexual flower, the upper 5 terminal ones subtending male flowers, membranaceous, hyaline to ochraceous. Bisexual flower 1, styles undivided to shortly bifid at apex, stamens 3, anthers 1.9–3.8 mm long, apex obtuse to mucronate in bisexual and male flowers; male flowers 5. Nutlets 4.2–4.4 × 1.1–1.6 mm (without the style base), oblanceoloid, brownish, margins yellowish, concave surface microreticulate, punctuate, papillose, convex surface punctuate, papillose, silica bodies present, recurved in transverse section, margins incurved, the margins

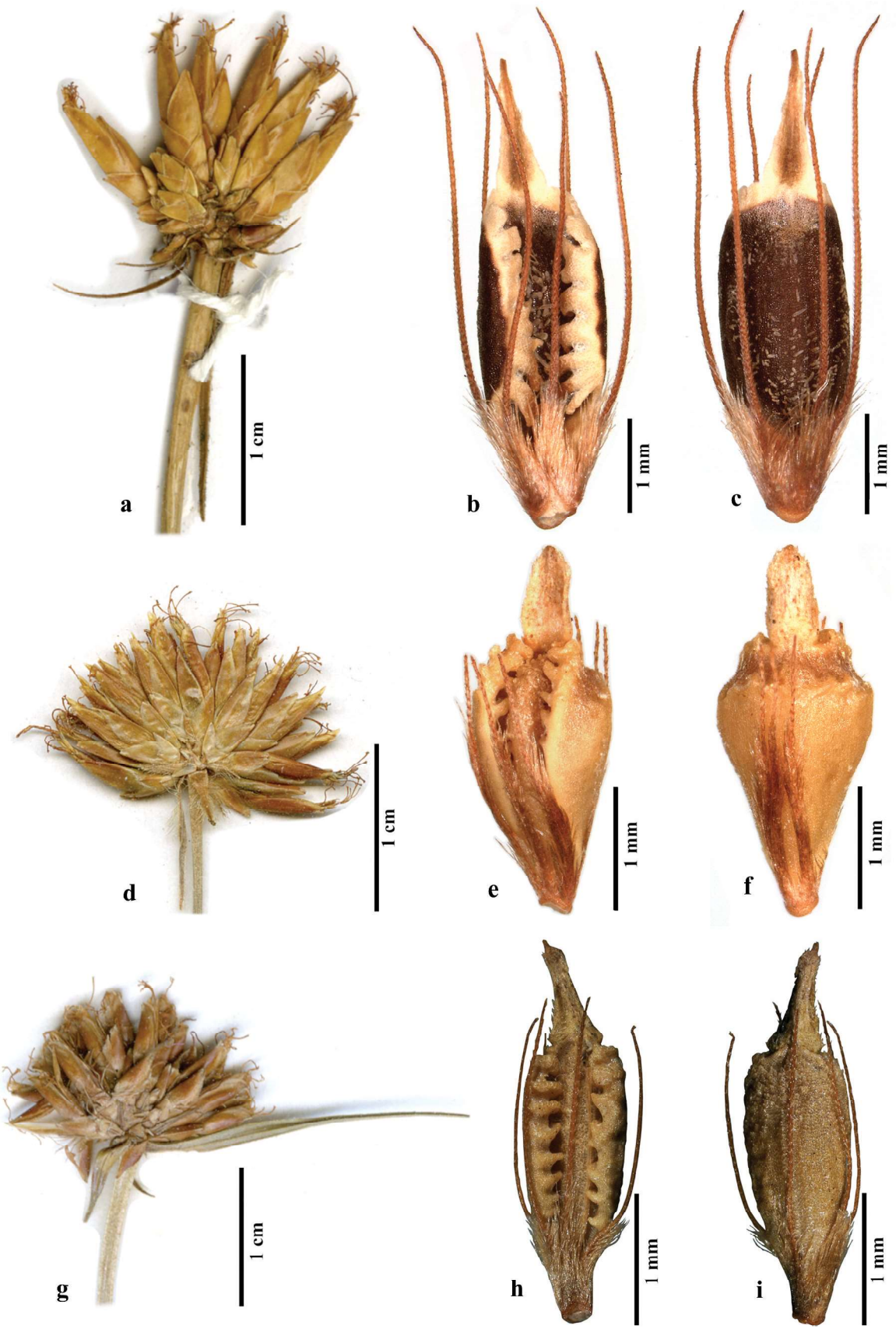

Figure 4. *Rhynchospora psammophila*, morphological characters compared with closer taxa. *Rhynchospora psammophila*, [illustrations from Pastore M. & Santos M. S. 1313 (MG)]. a –Inflorescence; b – nutlet, concave side; c – nutlet, convex side. *Rhynchospora trichochaeta*, [illustrations from nascimento H. T. S. do 1128 (UFP)]. d – inflorescence; e – nutlet, concave side; f – nutlet, convex side. *Rhynchospora subplumosa*, [illustrations from Rodrigues I. A. & Dantas M. 758 (IAN)]. g – Inflorescence; h – nutlet, concave side; i – nutlet, convex side.

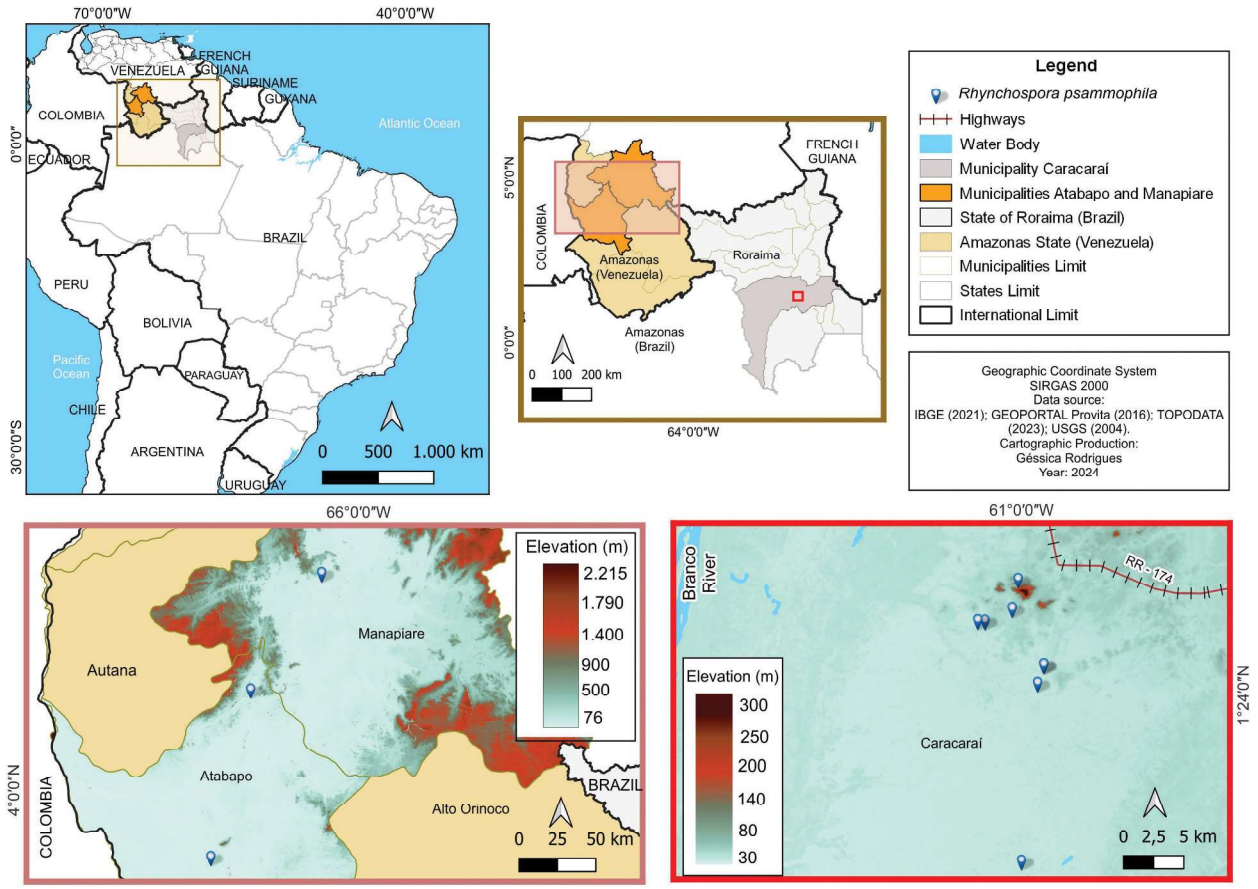

Figure 5. Distribution map of *Rhynchospora psammophila*.

lobed. Style base 1.9–2.2 × 0.4–0.8 mm, narrowly triangular, midvein conspicuous, especially on convex surface, base entire to shallowly 2-lobed, apex narrowly acuminate, margins antrorsely scabridulous, yellowish to greenish, with a basal constriction, not decurrent. Perianth bristles 5, 4.2–5.7 mm long, plumose up to 1.3–2 mm of the bristles length, distally antrorsely scabridulous, exceeding the nutlet, exceeding or not the style base.

Distribution and habitat

Rhynchospora psammophila is known from the Viruá National Park, in the municipality of Caracaraí, Roraima state, northern Brazil, and from the Yapacana National Park, near the mountains "Cerro Yapacana", "Caño Cotúa", "Caño Picure"; and in the "Caño Camani" valley, Amazonas State, Venezuela (Figures 5 and 6). The Yapacana National Park is located to the southeast of the confluence of the Orinoco and Ventuari rivers and is composed mostly of lowland habitats (Huber 1995). The "Caño Camani" mountain flows out of a mountain system with typical table mountains ("tepuis") formed of sandstone of the Roraima Formation (Huber and Wurdack 1984).

The main habitat of *R. psammophila* in Roraima state, Brazil, are the campinaranas (Figure 6), which are seasonally flooded savannas (Pires and Prance 1985; Mota et al. 2015). It is a vegetation type rich in Poales species such as Cyperaceae, Eriocaulaceae, Rapateaceae, and Xyridaceae (Pires and Prance 1985; Mota et al. 2015).

In the Amazonas State, Venezuela, there are seasonal grass savannas, where *R. psammophila* occurs, some of these periodically flooded, as in the Manapiare river valley (Huber 1995). On the Upper Orinoco, the lowland meadows with sandy soils, known in Brazil as white-sand savannas, campinas or campinaranas, has similar plant communities with the Guiana Shield vegetation in Guyana, Brazil and Colombia (Huber 1995).

Preliminary conservation status

The species has an Extent of Occurrence (EOO) of 78,703 km^2, and according to the criteria B1 of the IUCN would be categorized as Least Concern (LC). However, the state of Amazonas in Venezuela is situated within the "Orinoco Mining Arc," where mining activities have been ongoing for 15 years. These activities have impacted at least 43 localities within protected areas of the Guiana Highlands, including the Yapacana National Park (Lozada et al. 2020). The mining activities in the

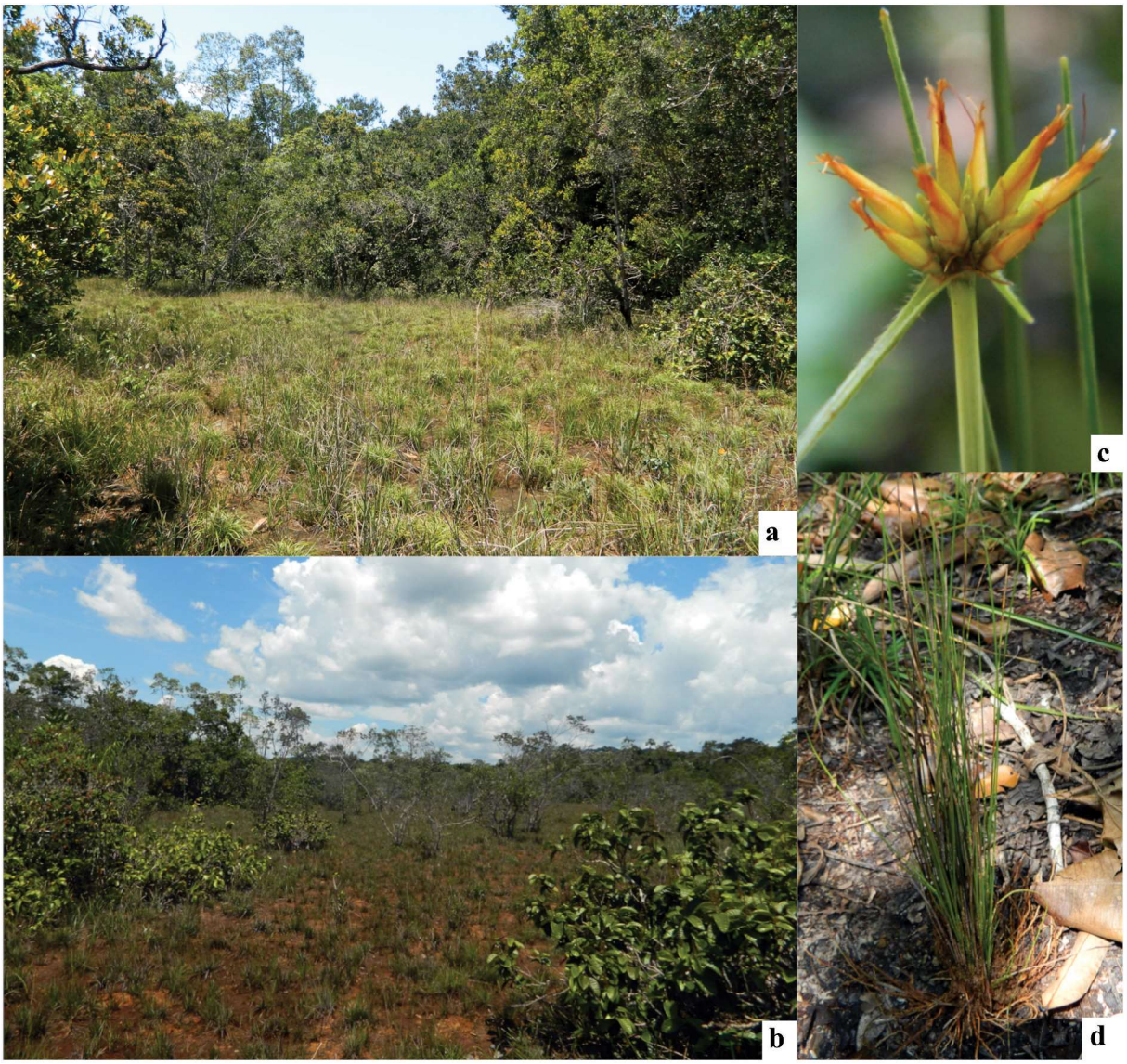

Figure 6. a–b. Habitat of *Rhynchospora psammophila* at the Viruá National Park, Roraima state, Brazil; c. Detail of the inflorescence; d. Plant habit. Photos by Mayara Pastore.

Amazonas State may represent inferred or projected decline in the quality of habitat [according to the IUCN subcriteria B2b(iii) (IUCN 2022)]. The Area of Occupancy of the species (AOO) is of 44 km^2, and due to the estimated AOO less than 500 km^2, the existence of no more than 5 known locations, and the continuing decline projected or inferred of area, extent or quality of habitat, [B2ab(iii)], the species can be categorized as Endangered (EN).

Additional specimens examined (paratypes)

Brazil. Roraima: Caracaraí, Parque Nacional do Viruá, 1°25'35"N 60°59'00"W, 16 July 2010, *T.D.M. Barbosa et al. 11223* (UEC-photo!); Campina na estrada

Table 1. Main morphological character differences between *R. psammophila*, *R. subplumosa*, and *R. trichochaeta*.

Characteristic	*R. psammophila*	*R. subplumosa*	*R. trichochaeta*
Base	Not bulb-like	Bulb-like	Not bulb-like
Rhizomes	Horizontally creeping, squamose, conspicuous, with 1.7–3.5 mm wide, often knotty	Horizontally creeping, squamose or not, conspicuous, with 1.2–6.2 mm wide, knotty	Not creeping, not squamose, inconspicuous, with 1.2–2.2 mm wide
Spikelets length	7–9.3 mm long	4–9 mm long	3.5–8 mm long
Basal sterile glumes	4 per spikelet	3 per spikelet	3 per spikelet
Nutlets length	4.2–4.4 mm long	2.6-3 mm long	2.3–3 mm long
Nutlets margins	Lobed	Serrulate	Serrulate
Style base length	1.9–2.2 mm long	0.7–1.3 mm long	0.9–1.6 mm long
Perianth bristles	5 per nutlet, 4.2–5.7 mm long	6 per nutlet, 3.8–4.2 mm long	6 per nutlet, 1.5–4.1 mm

Perdida, 1°16'48.0"N 61°00'00.0"W, 21 July 2010, *E. Pessoa et al. 330* (INPA); margem da estrada perdida, 102 m, 1°24'45.9"N 60°59'16.7"W, 6 November 2008, *S. Martins et al. 293* (UFP, HRCB); Grade PPBIO (L4N4), 1°27'34.2"N 61° 01'57.1"W, 27 July 2010, *Barbosa T.D.M. & Costa S. M. 1372* (INPA); Grade PPBio NS4, campina, 1° 29'25.1"N 61°00'09.0"W, 2006, *F. R. C. Costa 1661* (INPA); grade do PPBio, 1°28'05.8"N 61°00'24.8"W, 24 July 2010, *T. D. M. Barbosa & S. M. Costa 1326* (INPA, UEC-photo); Parque Nacional do Viruá, 1° 25'35"N 60°59'00"W, 16 July 2010, *T. D. B. Barbosa 1122* (INPA). Venezuela. T. F. Amazonas: Atures, sabana ubicada en la parte alta del Caño Picure, aprox. 95 km al NNE de Sta. Bárbara, 4°37' N, 66°38' W, 200 m, 30 June 1979, *O. Huber 3997* (NY); sabanas ubicadas em la llanura del Valle del Caño Camani, al W del Cerro Morrocoy y a unos 10 km al W de San Juan de Manapiare, 5°18'N, 66°13'W, 150 m., 10 October 1979, *O. Huber 4646* (NY); area between the western base of Cerro Yapacana and the headwaters of Caño Cotúa; elev. ca. 100 m, 66°52'W, 3° 38'N, savanna II, 6 May 1979, *G. Davidse et al. 17240* (NY).

Discussion

The new species is classified in *Rhynchospora* sect. *Pauciflorae* subsect. *Plumoso-setosae* Kük. and is morphologically similar to *R. trichochaeta* C.B. Clarke and *R. subplumosa* C.B. Clarke because of its hemispherical, head-like inflorescences, and its basally plumose perianth bristles (Kükenthal 1949).

Rhynchospora psammophila is morphologically closer to *R. subplumosa* C.B. Clarke, which also occurs in Roraima state, northern Brazil, differing by the bulb-like base, the basal sterile glumes 3 per spikelet, nutlets with 2.6–3 mm long, style base with 0.7–1.3 mm long, and with 6 perianth bristles in *R. subplumosa* (vs. not bulb-like base, the basal sterile glumes 4 per spikelet, nutlets with 4.2–4.4 mm long, style base with 1.9–2.2 mm long, and with 5 perianth bristles in *R. psammophila*, Table 1, Figure 4).

Rhynchospora trichochaeta C.B. Clarke is also morphologically closer to *R. psammophila* and occurs in Viruá National Park. Costa et al. (2016) identified the collection *T.D.M. Barbosa 1326* (INPA, UEC) as the species. However, it can be distinguished by the rhizomes horizontally creeping, squamose, conspicuous, with 1.7–3.5 mm wide, often knotty, spikelets longer with 7–9.3 mm, nutlets longer with 4.2–4.4 mm, with the lobed margins, style base longer with 1.9–2.2 mm, and perianth bristles longer with 4.2–5.7 mm (*vs.* rhizomes not creeping, not squamose, inconspicuous, with 1.2–2.2 mm wide, not knotty, spikelets shorter with 3.5–8 mm, nutlets shorter with 2.3–3 mm, with the margins serrulate, style base shorter with 0.9–1.6 mm, and perianth bristles also shorter with 1.5–4.1 mm in *R. trichochaeta*, Table 1, Figure 4).

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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Data availability statement

The authors confirm that the data supporting the findings of this study are available within the article and its supplementary materials.

Author contributions

KNLA: specimen analysis, conservation status analysis, discussion of results, conceived the research, research funding acquisition. **WWT**: revision, writing, discussion of results, research funding acquisition, conceived the research. **ASBG**: revision, writing, discussion of results, research funding acquisition, conceived the research.

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