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RESEARCH ARTICLE

A new species of *Parianella* (Poaceae, Bambusoideae, Olyreae) marks the southernmost distribution of the genus in Brazil

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Abstract

Background and aims – *Parianella* is a relatively recently described genus of the subtribe Parianinae (Poaceae, Bambusoideae, Olyreae) that includes two species, and it is supposedly endemic to the Bahian Coastal Forests in the central region of Atlantic Forest, Brazil. Herein, we describe and illustrate a new species of the genus, comparing it with the other species of *Parianella*. We also provide an updated distribution map of the genus and the conservation status of the new taxon.
Material and methods – This study was based on the analysis of herbarium specimens and a literature review. The conservation assessment is based on field observations and spatial analyses, following IUCN guidelines and criteria.
Key results – During a review of the Poaceae collection of the MBML Herbarium, two Parianinae specimens with interesting features were found. A detailed morphological analysis revealed that these specimens belong to a new species of *Parianella*. The new taxon was collected in two localities in the southern portion of the Brazilian state of Espírito Santo, one in the municipality of Santa Leopoldina and the other in the Duas Bocas Biological Reserve, municipality of Cariacica. Both localities are situated in the Krenák-Waitaká Forests, one of the three subregions of the central Atlantic Forest region, and an area of great floristic diversity, including bamboo species.
Conclusion – *Parianella capixaba* represents the southernmost distribution of the genus known to date. With the description of this new species, the total number of bamboos in Espírito Santo state rises to 52 species in 18 genera.

Keywords

conservation, Espírito Santo, herbaceous bamboos, Krenák-Waitaká Forests, Parianinae

INTRODUCTION

Parianella Hollowell, F.M.Ferreira & R.P.Oliveira (Poaceae, Bambusoideae, Olyreae) is one of three monophyletic lineages of the subtribe Parianinae, and it includes two species (Ferreira et al. 2019). Like other Parianinae, *Parianella* has fimbriae at the apex of the leaf sheaths and spiciform synflorescences (Ferreira et al. 2019). Synflorescences of *Parianella* and *Pariana* Aubl. are composed only of gynecandrous whorls with four or five staminate spikelets surrounding a single central pistillate spikelet (Ferreira et al. 2013a). However, the former has staminate spikelets with elongated, laminar pedicels much longer than the associated spikelet, while *Pariana* has staminate spikelets with pedicels shorter than or equal to the associated spikelet (Ferreira et al. 2013a, 2019). This characteristic of the staminate spikelet is interpreted as a morphological synapomorphy of *Parianella* (Ferreira et al.

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2019). Microechinate-perforate ectexine ornamentation of the pollen grains is also interpreted as synapomorphic in *Parianella* (Ferreira et al. 2019), in contrast to the microechinate-areolate ectexine pattern observed in the *Pariana+Eremitis* clade (Dórea et al. 2017; Ferreira et al. 2019).

While *Pariana* (ca 28 species) is distributed throughout the Amazon Basin, extending into wet forests of Central America (Hollowell 1987; Judziewicz et al. 1999; Ferreira et al. 2019; Dias et al. 2021), *Eremitis* Döll (17 species) and *Parianella* have their distributions restricted to the Brazilian Atlantic Forest (Ferreira et al. 2013a, 2013b, 2016, 2019, 2020a, 2020b, 2020c, 2020d, 2021a, 2021b, 2022).

Despite being considered a hotspot for world biodiversity conservation (Mittermeier et al. 2004), the Atlantic Forest is one of the most endangered rain forests on Earth (Ribeiro et al. 2009; Joly et al. 2014). Formerly covering about 1.0 to 1.5 million km^2 in Brazil, from Rio Grande do Sul state (South region) to Rio Grande do Norte (Northeast region), the Atlantic Forest currently lies shattered into disconnected small forest fragments (Ranta et al. 1998; Ribeiro et al. 2009; Rezende et al. 2018). It is estimated that only 28% of its original vegetation cover is left in Brazil (Rezende et al. 2018). Even so, three centres of endemism can be recognized in the Atlantic Forest: northern (Pernambuco and Alagoas states), central (southern Bahia, north-eastern Minas Gerais, and Espírito Santo state), and southern (from Rio de Janeiro to Santa Catarina states) regions (Thomas et al. 1998; Murray-Smith et al. 2009). The central region, in turn, can be divided into three subregions, based on the shifts in availability of both humidity and solar radiation (energy) (Saiter et al. 2016). According to the latter authors, these subregions are: Bahia Interior Forests (moist and dry forests of north-eastern Minas Gerais and inland Bahia), Bahia Coastal Forests (BCF) (wet forests north of 18–19°S), and Krenák-Waitaká Forests (KWF) (moist forests south of 18–19°S, in Espírito Santo state). The entire territory of the state of Espírito Santo lies in the central region of the Atlantic Forest, split into the BCF and KWF subregions (Saiter et al. 2016; Alves-Araújo et al. 2022). The central region of the Atlantic Forest harbours high biodiversity and incidence of endemic and threatened species (Thomas et al. 1998; Martini et al. 2007; Ostroski et al. 2018), including bamboos (Soderstrom et al. 1988; Clark 1990; Oliveira et al. 2011; Ferreira et al. 2020a).

During a review of the Poaceae collection of the MBML Herbarium of the Instituto Nacional da Mata Atlântica (INMA), municipality of Santa Teresa, Espírito Santo state, two Parianinae specimens with interesting morphological features were found. After a careful analysis, it was confirmed that they belong to a new species of *Parianella*. The new species was collected in the municipalities of Santa Leopoldina and Cariacica, both in Espírito Santo. These localities are situated in the KWF subregion (Saiter et al. 2016). This is the first record of *Parianella* outside Bahia state and represents the southernmost distribution of the genus known so far. The total number of bamboos in Espírito Santo thereby rises to 52 species (nine endemics) and 18 genera. This finding reinforces the fact that Espírito Santo, along with Bahia and Minas Gerais, is an important centre of diversity for bamboos in Brazil (Soderstrom et al. 1988; Clark 1990; Oliveira et al. 2011; Ferreira et al. 2020a, 2020b, 2020c, 2020d, 2021a, 2021b, 2022).

MATERIAL AND METHODS

The morphological description and geographical distribution of the new species were based on the specimens housed in the herbaria CEPEC, HUEFS, MBML, RB, and UPCB (acronyms according to Thiers 2022). Morphological characters of the other two congeneric species were taken from their type specimens [*Parianella carvalhoi* (R.P.Oliveira & Longhi-Wagner) F.M.Ferreira & R.P.Oliveira, *Carvalho 4382* (CEPEC, holotype); *P. lanceolata* (Trin.) F.M.Ferreira & R.P.Oliveira, *Riedel s.n.* (K [K000001173], isotype), and original descriptions (Oliveira et al. 2004; Trinius 1834 [1835]). We used Tutin (1936), Hollowell (1987), and Judziewicz et al. (1999) for morphological bamboo terminology. We followed Harris and Harris (2001), and Gonçalves and Lorenzi (2011) for the classification of leaves, reproductive structure forms, and indumentum. Measurements of the vegetative and reproductive structures were taken using a metal calliper with 0.02 mm precision, following Hollowell (1987) and Ferreira et al. (2013a).

An updated distribution map of the genus was made using SimpleMappr (Shorthouse 2010) based on the specimens deposited in the herbaria visited (ALCB, BHCB, CEPEC, CVRD, ESA, GUA, HUEFS, HUFU, INPA, ISC, LE, MBM, MBML, MO, NY, P, PEUFR, R, RB, RBR, SP, SPF, UEC, UESC, UPCB, US, and VIC) or available at online platforms: Tropicos (https://www.tropicos.org), Smithsonian National Museum of Natural History (https://collections.nmnh.si.edu), New York Botanical Garden (https://sweetgum.nybg.org/science/vh), Muséum national d'Histoire naturelle (https://science.mnhn.fr), Meise Botanic Garden (https://www.botanicalcollections.be), SpeciesLink system (https://specieslink.net), and Flora e Funga do Brasil (https://floradobrasil.jbrj.gov.br).

The assessment of the conservation status of the new species follows the IUCN Red List categories and criteria (IUCN Standards and Petitions Committee 2022), and was also based on those specimens examined in the herbaria or online. Area of occupancy (AOO) was calculated using the GeoCAT tool (Bachman et al. 2011), considering 2 km^2 grids. It was not possible to calculate extent of occurrence (EOO) since the new species is only known from two localities so far.

Table 1. Comparison of the morphology and geographical distribution of species of *Parianella*.

Characters	*Parianella capixaba*	*P. carvalhoi*	*P. lanceolata*
Rhizomes	present, well-developed	present, poorly developed	present, poorly developed
Culms			
Diameter (mm)	3–5.5	2–4	1–2.5
Nodes	glabrous	glabrous	pilose
Fimbriae	present, persistent, 29–72 per leaf sheath, spreading, straight at the base, curly towards the top	absent or vestigial, when present caducous, 1–3 per leaf sheath, adpressed to the culm, straight	present, persistent, (8–)13–25 per leaf sheath, spreading, straight
Fimbriae length (mm)	10–35	< 1	7–20
Ligule length (mm)	1.5–2	0.3–0.5	0.7–1.2
Leaf blades (cm)	40–47 × 4–5	(6–)11.5–20 × 2.1–3.4	(7.5–)11–16(–21.4) × 0.7–1.7(–2.5)
Synflorescence length (cm)	ca 15	6.5–8	5–8
Staminate spikelets			
Length (mm)	4–5	2–2.5	2.5–3.2
Pedicel length (mm)	9–13	7–8.2	7.2–8
Glume length (mm)	3.5–4	2–3	2.2–3
Geographical distribution (Brazilian state)	Espírito Santo	Bahia	Bahia

TAXONOMIC TREATMENT

Parianella capixaba F.M.Ferreira & R.P.Oliveira, **sp. nov.**
urn:lsid:ipni.org:names:77309830-1
Figs 1, 2, Table 1

Type. BRAZIL • Espírito Santo, Santa Leopoldina, Serra do Ramalhete, Caioaba Farm; 15 Feb. 2006; *V. Demuner*, *L.F.S. Magnago*, *M. Belisário & E. Bausen 1828*; holotype: MBML [MBML00019821].

Diagnosis. *Parianella capixaba* is similar to the other two congeneric species in its culm length and gynecandrous whorl length and width, but can be differentiated by its well-developed rhizomes, longer and wider leaf blades, longer synflorescences, and longer staminate spikelets with longer pedicels and glumes.

Description. Plants perennial, caespitose, with well-developed rhizomes. Culms monomorphic, erect, 50–90 cm long, 3–5.5 mm diam. near the base; internodes striate, glabrous; nodes thickened, glabrous; leaves 5–6 per culm; leaf sheaths slightly keeled, not inflated, glabrous to slightly pilose, margins ciliate, fimbriae at the apex present, persistent, 29–72 per leaf sheath, spreading, straight at the base, curly towards the top, 10–35 mm long; ligules entire, 1.5–2 mm long; pseudopetioles 1–2 × 1–2 mm, stramineous, glabrous on both sides; leaf blades 40–47 × 4–5 cm, lanceolate, base attenuate, symmetric, apex acuminate, concolor, glabrous on both sides, margins scabrous. Synflorescences ca 15 cm long, terminal, solitary, with only gynecandrous whorls; gynecandrous whorls 10–15 × 4–6 mm, ca 7 per synflorescence; pistillate spikelet 1 per whorl; staminate spikelets 5 per whorl. Pistillate spikelets 9–10 × 3–4 mm, oblong, stramineous; glumes 9–10 × 3–4 mm, membranous, hyaline, lanceolate to oblong, acuminate to shortly caudate, glabrous to slightly pilose, 1-nerved; lemma 8–9 × 3–4 mm, cartilaginous, oblong, apex acuminate, glabrous at the base and shortly scabrous at the apex, 8-nerved; palea 8–9 × 2.5–3 mm, cartilaginous, lanceolate, apex acuminate, glabrous at the base and slightly scabrous at the apex, 2–4-nerved. Caryopsis not seen. Staminate spikelets 4–5 × 1.5–2 mm, oblong; pedicels 9–13 mm long, laterally connate in two pairs plus one free pedicel (2 + 2 + 1 pattern), pilose at the base; glumes 3.5–4 × 0.7–1.3 mm, papyraceous, triangular, apex acute, pilose to slightly scabrous, 1-nerved; lemma 4–5 × 1.5–2 mm, papyraceous, oblong to ovate, apex obtuse to acute, glabrous at the base and slightly villous at margins and apex, 3-nerved; palea 3.5–4.5 × 1–1.5 mm, papyraceous, oblong to ovate, apex obtuse to rounded, glabrous or pilose to villous towards the apex, 2-nerved; anthers not seen. Spikelet of the terminal whorl not seen.

Distribution. This new species is known from only two localities in the Brazilian state of Espírito Santo, both of them in its southern portion: one in the Serra do Ramalhete (municipality of Santa Leopoldina, ranging from 200 to 500 m in elevation), and the other in the Duas Bocas Biological Reserve (municipality of Cariacica, at ca 525 m elevation) (Fig. 2).

Habitat and ecology. Both localities lie in the Krenák-Waitaká Forests (KWF) (Saiter et al. 2016; Alves-Araújo et al. 2022), one of the three subregions in the central centre of endemism of the Atlantic Forest (Thomas et al. 1998; Murray-Smith et al. 2009). The vegetation of this region is

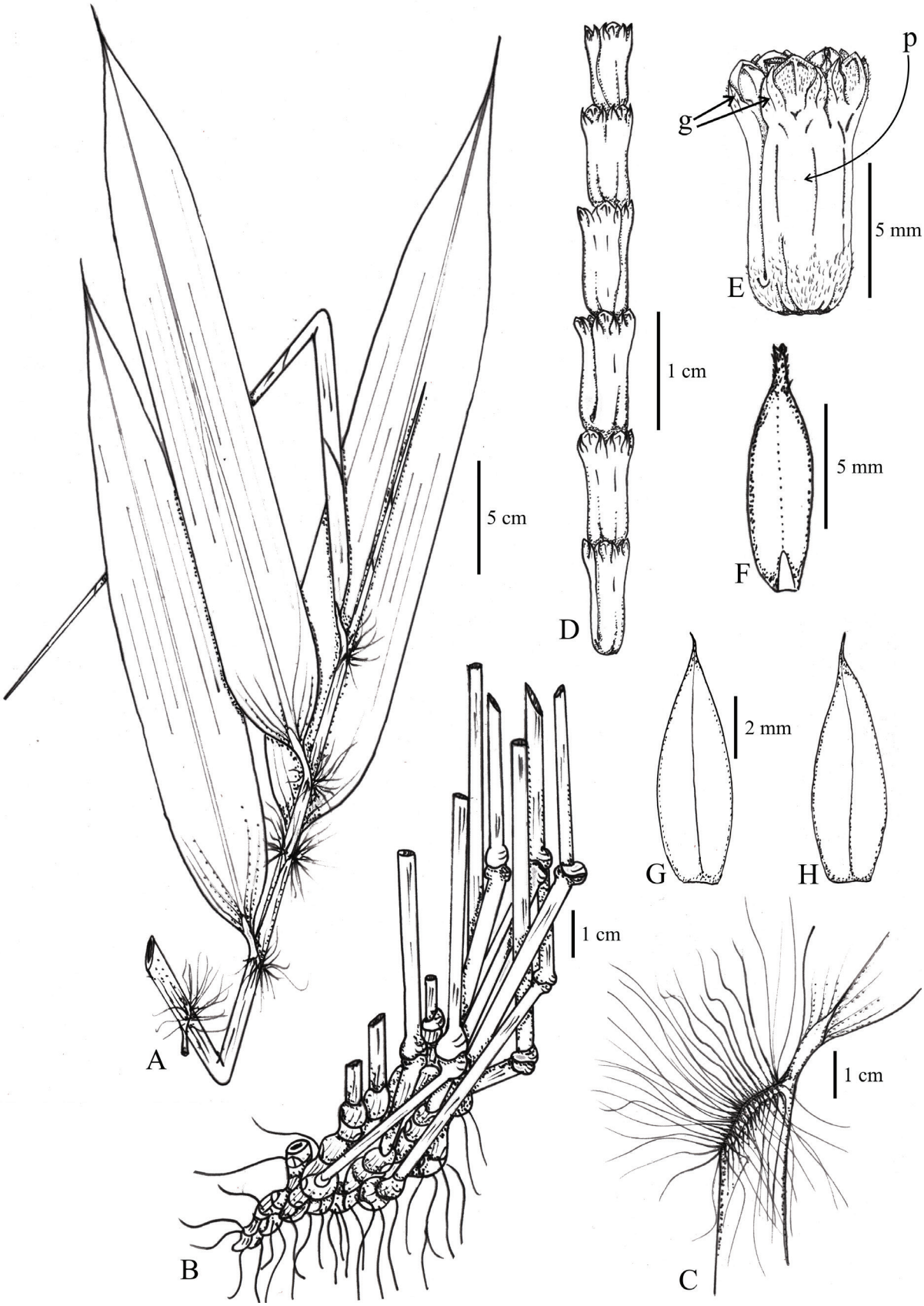

Figure 1. *Parianella capixaba* sp. nov. **A**. Culm. **B**. Rhizome. **C**. Detail of the leaf sheath apex showing pseudopetiole and fimbriae. **D**. Synflorescence. **E**. Gynecandrous whorl showing staminate spikelets with glumes (g) and long pedicels (p). **F**. Lemma of the pistillate spikelet. **G**–**H**. Glumes of the pistillate spikelet (abaxial view). Drawn by Fabrício Moreira Ferreira; A–B: from the paratype (*C.N. Fraga et al. 2183*, HUEFS000013599); C–H: from the holotype (*V. Demuner et al. 1828*, MBML00019821).

characterized as a semi-deciduous seasonal submontane forest, due to climatic conditions, altitudinal ranges, and soil types (Assis et al. 2007). *Parianella capixaba* represents the southernmost distribution of the genus known so far since the other two species (*P. carvalhoi* and *P. lanceolata*) are endemic to Bahia state.

Etymology. The specific epithet "capixaba" is a noun in apposition and the local name for Espírito Santo inhabitants. The epithet also alludes to the first record of the genus *Parianella* outside Bahia state.

IUCN conservation assessment. Endangered: EN B2ab(ii,iii,iv). According to the IUCN Standards and Petitions Committee (2022), *Parianella capixaba* would be considered Endangered (EN), based on criteria B2ab(ii,iii,iv), with an AOO of 8 km^2. Although the species occurs in a Conservation Unit (Duas Bocas Biological Reserve, Espírito Santo, Brazil), we suggest this category based on its very restricted distribution. Furthermore, the Atlantic Forest is one of the most endangered biodiversity hotspots (Ribeiro et al. 2009; Rezende et al. 2018), especially in Espírito Santo state, where urbanization and industrial and agricultural expansion have led to a great loss and fragmentation of the vegetation (Pereira 2007; Alves-Araújo et al. 2022).

Additional material examined (paratypes). BRAZIL – **Espírito Santo** • Cariacica, Duas Bocas Biological Reserve; 22 Jul. 2008; *C.N. Fraga, A.M.A. Amorim, R.C. Forzza, P.H. Labiack, R. Goldenberg, J.L. Paixão & L.C.J. Gomes 2183*; RB [RB00549297]; CEPEC n. 130402; HUEFS [HUEFS000013599]; MBML [MBML00019822, MBML00019823]; UPCB [UPCB0038332].

Notes. *Parianella capixaba* overlaps morphologically with both *P. carvalhoi* and *P. lanceolata* in some characters (Table 1). However, the new species can be differentiated by its longer and wider leaf blades (40–47 × 4–5 cm vs (6–)11.5–20 × 2.1–3.4 cm in *P. carvalhoi* and (7.5–)11–16(–21.4) × 0.7–1.7(–2.5) cm in *P. lanceolata*), longer synflorescences (ca 15 cm long vs 6.5–8 cm in *P. carvalhoi* and 5–8 cm in *P. lanceolata*), and longer staminate spikelets (4–5 mm long vs 2–2.5 mm in *P. carvalhoi* and 2.5–3.2 mm in *P. lanceolata*) with longer pedicels (9–13 mm long vs 7–8.2 mm in *P. carvalhoi* and 7.2–8 mm in *P. lanceolata*) and longer glumes (3.5–4 mm long vs 2–3 mm in *P. carvalhoi* and 2.2–3 mm in *P. lanceolata*) (Table 1). A remarkable characteristic of the new species is its well-developed rhizomes, in contrast with both *P. carvalhoi* and *P. lanceolata*, which have poorly developed rhizomes (Judziewicz et al. 1999; Oliveira et al. 2004). The absence of well-developed rhizomes in the latter two species (treated as *Pariana* at that time) was considered by Soderstrom and Calderón (1974) as "primitive" (plesiomorphic) in comparison to *Pariana* from Amazon and Central America. However, according to Ferreira et al. (2019), the loss of a rhizome system in *Parianella* could be regarded as derived, which could be investigated with the well-developed rhizome observed in *P. capixaba*. More studies, including molecular phylogenetic analyses, are necessary to test this hypothesis.

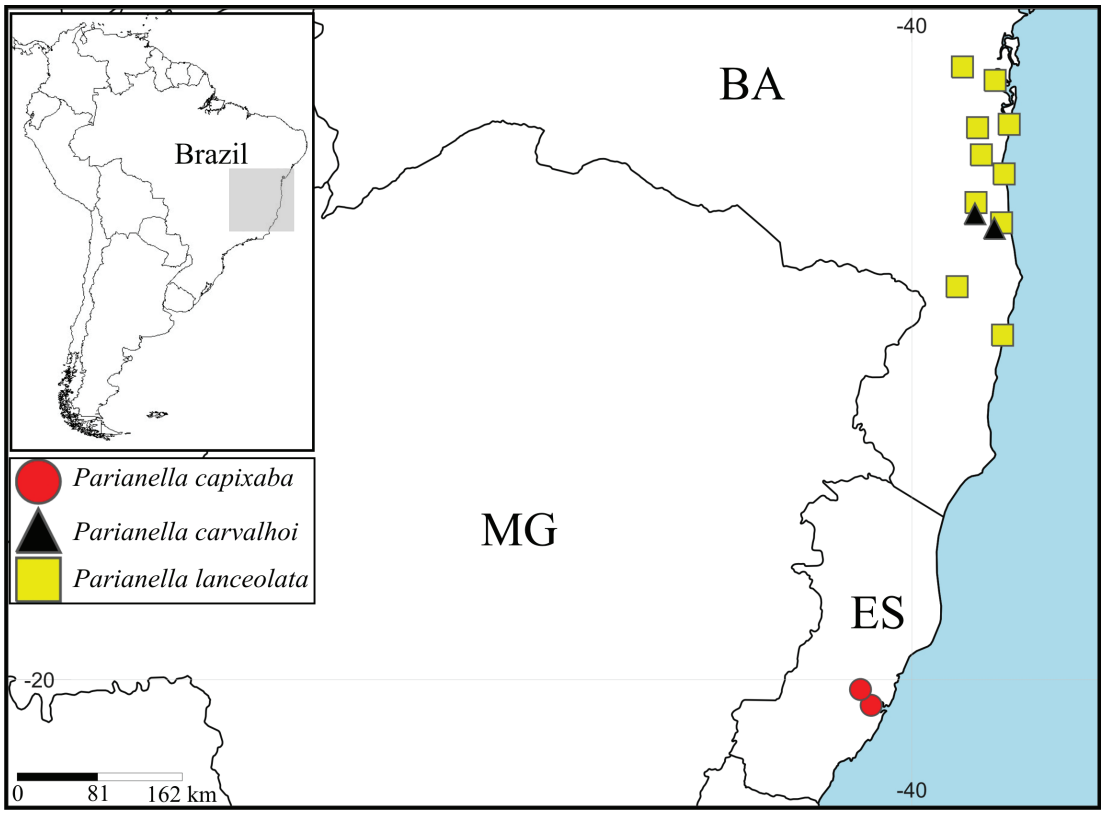

Figure 2. Geographical distribution of species of *Parianella*. Brazilian state abbreviations: BA – Bahia; ES – Espírito Santo; MG – Minas Gerais.

Key to the species of *Parianella*

1. Rhizomes well-developed; leaf blades 40–47 × 4–5 cm; synflorescences ca 15 cm long; staminate spikelets 4–5 mm long; pedicels of the staminate spikelets 9–13 mm long ..... ***Parianella capixaba* sp. nov.**
– Rhizomes poorly developed; leaf blades (6–)11–20(–21.4) × 0.7–3.4 cm; synflorescences 5–8 cm long; staminate spikelets 2–3.2 mm long; pedicels of the staminate spikelets 7–8.2 mm long **2**
2. Nodes glabrous; fimbriae absent or vestigial, when present caducous, 1–3 per leaf sheath, adpressed to the culm, < 1 mm long; ligules 0.3–0.5 mm long ..... ***P. carvalhoi***
– Nodes pilose; fimbriae present, persistent, (8–)13–25 per leaf sheath, spreading, 7–20 mm long; ligules 0.7–1.2 mm long ..... ***P. lanceolata***

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REFERENCES

Alves-Araújo A, Moreira MM, Carrijo TT, Lohmann LG, Lobão AQ, Scheidegger AF, Firmino AD, de Melo Silva AV, Nepomuceno A, Tuler AC, Amorim AMA, Moreira ALC, Cosenza BAP, Sossai BG, Silva C, Lopes CR, Monteiro D, Couto DR, Lima DF, Dalcin EC, Ramos F, Lírio EJ, Salimena FRG, de Oliveira FA, Fraga FRM, Torres-Leite F, Antar GM, Shimizu GH, Lima HC, Medeiros H, Luber J, Christ JA, Lanna J, Zorzanelli JPF, Freitas J, Pastore JFB, Melo JIM, Paula-Souza J, Oliveira JRPM, Pederneiras LC, Freitas L, Giacomin LL, Meireles LD, Silva LAE, Pinto LJS, Menini Neto L, Trovó M, Garbin ML, Morim MP, Ribeiro M, Pena NTL, Labiak PH, Cardoso PH, Viana PL, Moraes PLR, Moraes QS, Zorzanelli RF, Amaral RN, Asprino RC, Goldenberg R, Magnago R, Couto RS, Dutra SC, Hoyos-Gómez SE, Vieira TAF, Flores TB, Dutra VF, Miranda VS, Manhães VC, Forzza RC (2022) Floristic survey of vascular plants of a poorly known area in the Brazilian Atlantic Forest (Flona do Rio Preto, Espírito Santo). Biodiversity Data Journal 10: e75910. https://doi.org/10.3897/BDJ.10.e75910

Assis AM, Magnago LFS, Fernandes HQB (2007) Floresta Estacional Semidecidual de Terras Baixas, Submontanas e Montanas. In: Simonelli M, Fraga CN (Eds) Espécies Ameaçadas de Extinção no Estado do Espírito Santo. IPEMA, Vitória, 51–54.

Bachman S, Moat J, Hill AW, de la Torre J, Scott B (2011) Supporting Red List threat assessments with GeoCAT: geospatial conservation assessment tool. ZooKeys 150: 117–126. https://doi.org/10.3897/zookeys.150.2109

Clark LG (1990) Diversity and biogeography of Neotropical bamboos (Poaceae: Bambusoideae). Acta Botanica Brasilica 4(1): 125–132. https://doi.org/10.1590/S0102-33061990000100009

Dias KNL, Ferreira FM, Viana PL (2021) *Pariana caxiuanensis* (Parianinae, Poaceae): a new species of an enigmatic genus of herbaceous bamboos from the Brazilian Amazon. Phytotaxa 510(2): 171–178. https://doi.org/10.11646/phytotaxa.510.2.6

Dórea MC, Oliveira RP, Banks H, Santos FAR (2017) Sculptural elements on the ectexine surface of Poaceae pollen from Neotropical forests: patterns and implications for taxonomic and evolutionary studies in this family. Botanical Journal of the Linnean Society 185(4): 542–571. https://doi.org/10.1093/botlinnean/box073

Ferreira FM, van den Berg C, Hollowell VC, Oliveira RP (2013a) *Parianella* (Poaceae, Bambusoideae): morphological and biogeographical information reveals a new genus of herbaceous bamboos from Brazil. Phytotaxa 77(2): 27–32. https://doi.org/10.11646/phytotaxa.77.2.2

Ferreira FM, Dórea MC, Leite KRB, Oliveira RP (2013b) *Eremitis afimbriata* and *E. magnifica* (Poaceae, Bambusoideae, Olyreae): two remarkable new species from Brazil and the first record of blue iridescence in bamboo leaves. Phytotaxa 84(1): 31–45. https://doi.org/10.11646/phytotaxa.84.1.3

Ferreira FM, Hollowell VC, Oliveira RP (2016) *Eremitis linearifolia* and *E. robusta* (Poaceae, Bambusoideae, Olyreae): two new species of herbaceous bamboos from Brazil first collected over 30 years ago. Phytotaxa 280(2): 179–189. https://doi.org/10.11646/phytotaxa.280.2.8

Ferreira FM, Oliveira RP, Welker CAD, Dórea MC, Lima ALC, Oliveira ILC, Santos FAR, van den Berg C, Clark LG (2019) Phylogenetic relationships within Parianinae (Poaceae: Bambusoideae: Olyreae) with emphasis on *Eremitis*: evidence from nuclear and plastid DNA sequences, macromorphology, and pollen ectexine patterns. Molecular Phylogenetics and Evolution 139: 106541. https://doi.org/10.1016/j.ympev.2019.106541

Ferreira FM, Welker CAD, Santos-Gonçalves AP, Clark LG, Oliveira RP (2020a) A new species of *Eremitis* (Poaceae, Bambusoideae) from Rio Doce State Park, Minas Gerais, Brazil, marks the furthest inland distribution of the genus. Brittonia 72(2): 133–140. https://doi.org/10.1007/s12228-019-09603-x

Ferreira FM, Welker CAD, Clark LG, Oliveira RP (2020b) *Eremitis limae* (Poaceae, Bambusoideae), a new species of herbaceous bamboo endemic to the Atlantic Forest of Bahia, Brazil. Phytotaxa 454(4): 277–284. https://doi.org/10.11646/phytotaxa.454.4.5

Ferreira FM, Silva C, Welker CAD, Dórea MC, Leite KRB, Clark LG, Oliveira RP (2020c) *Eremitis berbertii* and *E. fluminensis* (Poaceae, Bambusoideae): new species

from the Brazilian Atlantic Forest and updates on leaf microcharacters in the genus. Novon 28(4): 240–252. https://doi.org/10.3417/2020562

Ferreira FM, Welker CAD, Clark LG, Oliveira RP (2020d) *Eremitis jardimii* (Poaceae, Bambusoideae), a new species from Bahia, Brazil. Kew Bulletin 75(4): 52. https://doi.org/10.1007/s12225-020-09906-3

Ferreira FM, Welker CAD, Clark LG, Oliveira RP (2021a) Reinterpretation of vegetative and reproductive characters validate three new species in the endangered herbaceous bamboo genus *Eremitis* (Poaceae, Bambusoideae, Olyreae) from the Atlantic Forest, Brazil. Systematic Botany 46(2): 321–332. https://doi.org/10.1600/036364421X16231782047352

Ferreira FM, Welker CAD, Oliveira RP (2021b) *Eremitis clarkiae* and *E. vinacea* (Poaceae, Bambusoideae): two new species of herbaceous bamboos endemic to the Atlantic Forest of southern Bahia, Brazil increase the diversity of the genus in this hotspot. Plant Ecology and Evolution 154(3): 470–482. https://doi.org/10.5091/plecevo.2021.1818

Ferreira FM, Welker CAD, Clark LG, Oliveira RP (2022) A new species of *Eremitis* (Poaceae, Bambusoideae) from the Baixo Jequitinhonha region, an area of extreme importance for the conservation of the flora of Minas Gerais, Brazil. Acta Botanica Brasilica 36: e2021abb0030. https://doi.org/10.1590/0102-33062021abb0030

Gonçalves EG, Lorenzi H (2011) Morfologia vegetal. Second edition. Instituto Plantarum de Estudos da Flora Ltda, Nova Odessa, 1–546.

Harris JG, Harris MW (2001) Plant identification terminology: an illustrated glossary. Second edition. Spring Lake Publishing, Spring Lake, 1–206.

Hollowell VC (1987) Systematics of the Subtribe Parianinae (Poaceae: Bambusoideae: Olyreae). Ph.D. thesis, University of South Carolina, USA.

IUCN Standards and Petitions Committee (2022) Guidelines for using the IUCN Red List categories and criteria. Version 15.1. https://www.iucnredlist.org/resources/redlistguidelines [accessed 25.11.2022]

Joly CA, Metzger JP, Tabarelli M (2014) Experiences from the Brazilian Atlantic Forest: ecological findings and conservation initiatives. New Phytologist 204(3): 459–473. https://doi.org/10.1111/nph.12989

Judziewicz EJ, Clark LG, Londoño X, Stern M (1999) American bamboos. Smithsonian Institution Press, Washington D.C., 1–398.

Martini AMZ, Fiaschi P, Amorim AM, Paixão JL (2007) A hot-point within a hot-spot: a high diversity site in Brazil's Atlantic Forest. Biodiversity and Conservation 16(11): 3111–3128. https://doi.org/10.1007/s10531-007-9166-6

Mittermeier RA, Robles-Gil P, Hoffmann M, Pilgrim JD, Brooks TB, Mittermeier CG, Lamoreux JL, Fonseca GAB (2004) Hotspots revisited: Earth's biologically richest and most endangered ecoregions. CEMEX, Mexico City, 1–392.

Murray-Smith C, Brummitt NA, Oliveira-Filho AT, Bachman S, Moat J, Lughadha EMN, Lucas EJ (2009) Plant diversity hotspots in the Atlantic coastal forests of Brazil. Conservation Biology 23(1): 151–163. https://doi.org/10.1111/j.1523-1739.2008.01075.x

Oliveira RP, Longhi-Wagner HM, Hollowell VC (2004) A new species of *Pariana* (Poaceae: Bambusoideae: Olyreae) endemic to the Atlantic Moist Forest in the State of Bahia, Brazil. Novon 14(2): 206–209. https://www.jstor.org/stable/3393318

Oliveira RP, Longhi-Wagner HM, Jardim JG (2011) Diversidade e conservação dos bambus herbaceous (Poaceae: Bambusoideae: Olyreae) da Mata Atlântica. In: Almeida JG, Teixeira AA (Orgs) Anais do Seminário Nacional de Bambu. CPAB, Universidade de Brasília, Brasília, 62–66.

Ostroski P, Saiter FZ, Amorim AMA, Fiaschi P (2018) Endemic angiosperms in Bahia Coastal Forests, Brazil: an update using a newly delimited area. Biota Neotropica 18(4): e20180544. https://doi.org/10.1590/1676-0611-bn-2018-0544

Pereira OJ (2007) A cobertura vegetal no Estado do Espírito Santo. In: Simonelli M, Fraga CN (Eds) Espécies Ameaçadas de Extinção no Estado do Espírito Santo. IPEMA, Vitória, 17–20.

Ranta P, Blom T, Niemela J, Joensuu E, Siitonen M (1998) The fragmented Atlantic rain forest of Brazil: size, shape and distribution of forest fragments. Biodiversity and Conservation 7(3): 385–403. https://doi.org/10.1023/A:1008885813543

Rezende CL, Scaranoa FR, Assadd ED, Joly CA, Metzger JP, Strassburg BBN, Tabarelli M, Fonseca GA, Mittermeier RA (2018) From hotspot to hopespot: an opportunity for the Brazilian Atlantic Forest. Perspectives in Ecology and Conservation 16(4): 208–214. https://doi.org/10.1016/j.pecon.2018.10.002

Ribeiro MC, Metzger JP, Martensen AC, Ponzoni FJ, Hirota MM (2009) The Brazilian Atlantic Forest: how much is left, and how is the remaining forest distributed? Implications for conservation. Biodiversity and Conservation 142(6): 1141–1153. https://doi.org/10.1016/j.biocon.2009.02.021

Saiter FZ, Brown JL, Thomas WW, de Oliveira-Filho AT, Carnaval AC (2016) Environmental correlates of floristic regions and plant turnover in the Atlantic Forest hotspot. Journal of Biogeography 43(12): 2322–2331. https://doi.org/10.1111/jbi.12774

Shorthouse DP (2010) SimpleMappr, an online tool to produce publication-quality point maps. https://www.simplemappr.net/ [accessed 10.09.2022]

Soderstrom TR, Calderón CE (1974) Primitive forest grasses and evolution of the Bambusoideae. Biotropica 6(3): 141–153. https://doi.org/10.2307/2989646

Soderstrom TR, Judziewicz EJ, Clark LG (1988) Distribution patterns of Neotropical bamboos. In: Vanzolini PE, Heyer WR (Eds) Proceedings of a workshop on Neotropical distribution patterns. Academia Brasileira de Ciências, Rio de Janeiro, 121–157.

Thiers B (2022) Index Herbariorum: a global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. https://sweetgum.nybg.org/science/ih/ [accessed 25.11.2022]

Thomas WW, Carvalho AMV, Amorim AMA, Garrison J, Arbeláez AL (1998) Plant endemism in two forests in

southern Bahia, Brazil. Biodiversity and Conservation 7(3): 311–322. https://doi.org/10.1023/A:1008825627656

Trinius CB (1834) [1835] Panicearum genera retractavit speciebusque compluribus illustravit. Mémoires de l'Académie Impériale des Sciences de St.-Pétersbourg. Série 6, Sciences Mathématiques, Physiques et Naturelles, Tome 3(2): 89–355. https://www.biodiversitylibrary.org/item/91273#page/97 [accessed 25.11.2022]

Tutin TG (1936) A revision of the genus *Pariana* (Gramineae). Botanical Journal of the Linnean Society 50(334): 337–362. https://doi.org/10.1111/j.1095-8339.1936.tb02003.x