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 Parianiniae (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 Parianiniae 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, Parianiniae

INTRODUCTION

*Parianella* Hollowell, F.M.Ferreira & R.P.Oliveira (Poaceae, Bambusoideae, Olyreae) is one of three monophyletic lineages of the subtribe Parianiniae, and it includes two species (Ferreira et al. 2019). Like other Parianiniae, *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. 2013a).
2019). Microchinate-perforate ectexine ornamentation of the pollen grains is also interpreted as synapomorphous in *Parianella* (Ferreira et al. 2019), in contrast to the microchinate-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 shatterted 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 Espirito 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 Krenak-Waitaká Forests (KWF) (moist forests south of 18–19°S, in Espirito Santo state). The entire territory of the state of Espirito 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 MBM Herbarium of the Instituto Nacional da Mata Atlântica (INMA), municipality of Santa Teresa, Espirito Santo state, two Parianinaceae 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 Espirito 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 Espirito Santo thereby rises to 52 species (nine endemics) and 18 genera. This finding reinforces the fact that Espirito 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 [K00001173], 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).


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.
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 km². 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 5–8 cm 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 ........................................................................................................................................................................... 2
   – Nodes pilose; fimbriae present, persistent, (8–)13–25 per leaf sheath, spreading, 7–20 mm long; ligules 0.7–1.2 mm long ................................................................. P. carvalhoi

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