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Research article

Mollinedia lorencei (Monimiaceae, Laurales), a new species endemic to the Atlantic Forest in the state of Bahia, Brazil

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We provide a description and illustration of *Mollinedia lorencei*, sp. nov. The species exhibits morphological similarities and is compared to both *M. lamprophylla* and *M. dolichotricha*. Furthermore, we provide comments on the taxonomy, ecology, geographic distribution and conservation status of this new species.

Keywords: Flora of Bahia, Flora of Brazil, *Mollinedia lorencei*, Mollinediaceae, Mollinedioideae, new taxon, taxonomy, threatened species

Introduction

Monimiaceae (Laurales) comprises 28 genera and 195–200 species (Renner et al. 2010) with a disjunct distribution around the Pantropical region. The family can usually be found in well preserved forests throughout Tropical Africa, Sri Lanka, Australasia and the Neotropics (Philipson 1993, Renner et al. 2010). In the Neotropics, Monimiaceae are represented by three monotypic and three polytypic genera. *Peumus boldus* Molina is endemic to the sclerophyllous forests of central Chile. *Grazielanthus arkeocarpus* Peixoto & Pereira-Moura is microendemic to the Biological Reserve of Poço das Antas, in central region of the state of Rio de Janeiro. *Hennecartia omphalandra* J. Poiss. occurs in Argentina, Paraguay, Uruguay and south Brazil. Among the polytypic genera, two of them are endemic to Brazil, *Macropelys* Perkins with four species (Santos and Peixoto 2001) and *Macrotorus* Perkins with two species (Lício et al. 2020a). *Mollinedia* Ruiz & Pav. is the richest genus with ca 60 species that occurs from Mexico to South America, except in Argentina, Chile and Uruguay (Lício et al. 2020b).

Mollinedia is characterized by its almost rounded flower buds, staminate receptacles concave, flat or short urceolate, with four tepals, ratio receptacle and tepals length ca 1:1, stamens numerous, anthers ovate, elliptical or oblong, pistillate flowers with the upper part circumcised, such as a calyptra, carpels free, numerous, and fruit



composed of free drupelets (Perkins 1900, Philipson 1993, Lírío and Peixoto 2015, Lírío et al. 2020a). Brazil is the center of diversity of *Mollinedia*, with 38 species, 35 of which are endemic to the country. Moreover, the Atlantic Forest encompasses 33 species, 30 of them endemic to the biome (Lírío et al. 2020b).

The Atlantic Forest is considered a biodiversity hotspot due to the occurrence of a high number of endemic and threatened species (Myers et al. 2000). It consists of two main types of vegetation: the ombrophilous forest, also known as Atlantic rainforest, and the seasonal tropical forest, also known as semideciduous Atlantic Forest. The Atlantic rainforest encompasses the low to mid elevations (~ 1000 m a.s.l.) of the mountain range running along the south to northeast coast of Brazil and is characterized by a warm and humid climate without a dry season. The seasonal tropical forest extends along the plateau (usually > 600 m a.s.l.) in the central and southeastern interior of the country. It experiences a seasonal climate with a relatively severe dry season from April to September (Morellato and Haddad 2000, Oliveira-Filho and Fontes 2000).

The state of Bahia (northeastern Brazil) encompasses the Atlantic Forest in the southern and eastern regions, Caatinga in the central and northern regions, and Cerrado in the western region (IBGE 2019). The Atlantic rainforest of Bahia presents high levels of endemism (Aguiar et al. 2003, Prado et al. 2003). Two sites in southern Bahia were recorded as having one of the highest levels of plant species richness in the world (Thomas et al. 1998). The richness of this biome in Bahia has led to the discovery of a new species of *Mollinedia*, which is here described and compared to two similar species: *Mollinedia dolichotricha* Lírío & Peixoto and *Mollinedia lamprophylla* Perkins. We also provide illustrations, comments on its ecology, geographic distribution, and the conservation status of this new species.

Material and methods

Morphological terms follow Harris and Harris (2001), except for the characters unique to Monimiaceae, which follows Perkins (1898, 1900) and hair terminology, which follows Payne (1978). Nomenclature follows the latest Code (Turland et al. 2018). This work was based on physical herbaria visits (HURB, SPF), loans (CEPEC, HUEFS, RB) and data available in virtual herbaria and online databases (CRIA 2023, Reflora 2023).

EOO and AOO were calculated using the geospatial conservation assessment tool (GeoCat) (Bachman et al. 2011) and we followed the 'Guidelines' and the 'Categories and criteria' of IUCN (2012, 2022) to assess the preliminary extinction risk of the new species. The distribution map was created using QGIS ver. 3.30, the coordinates were obtained from the original vouchers, and, when necessary, georeferenced by the authors based on locality information.

Taxonomic treatment

Mollinedia lorencei Borges-Lima, Zavatin & Lírío, sp. nov. (Fig. 1–3)

Diagnosis

The new species is similar to *M. dolichotricha* Lírío & Peixoto and *M. lamprophylla* Perkins. It differs from *M. dolichotricha* by the 2–3 m tall shrub habit (versus 5–14 m tall tree habit in *M. dolichotricha*), with 10–25 teeth on the leaves margin (versus 1–2 in *M. dolichotricha* or up to 9 teeth in young individuals), 41–53 stamens (versus 18–24 in *M. dolichotricha*) and bracteoles longer than the staminate flower (versus bracteoles shorter than the staminate flower in *M. dolichotricha*). *Mollinedia lorencei* differs from *M. lamprophylla* by the 2–3 m tall shrub habit (versus 3–10 m treelet or trees habit in *M. lamprophylla*), leaves and twigs with pilose indument (versus tomentose in *M. lamprophylla*), and drupelets 0.7–1.7 × 0.5–1.0 cm, pilose to glabrescent (versus 1.5–3.0 × 0.9–1.9 cm, velutinous in *M. lamprophylla*). These features are summarized on Table 1.



Figure 1. *Mollinedia lorencei* sp. nov. (Fiaschi, P. 1818). (A) Branch with staminate flowers, (B) leaf margin showing the line of trichomes, (C) detail of cataphylls, (D) detail of inflorescence, (E) staminate flower showing the stamens, (F) stamens. Drawing by Klei Sousa.

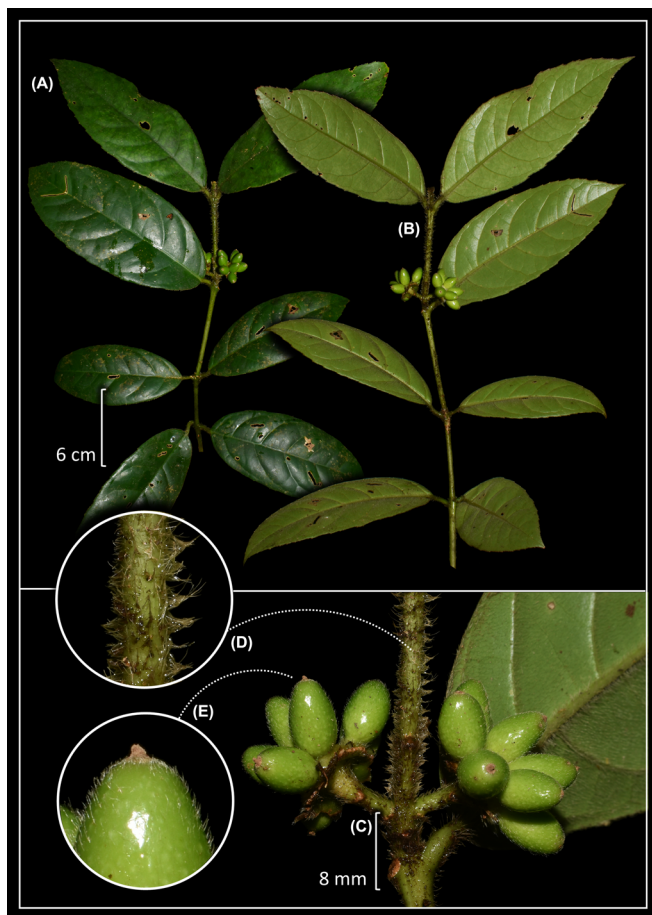


Figure 2. *Mollinedia lorencei* sp. nov. (Vieira, T. L. 368). (A) Branch with fruits showing the adaxial face of the leaves, (B) branch with fruits showing the abaxial face of the leaves, (C) immature fruits, (D) detail of the branch trichomes, (E) detail of the trichomes and a persistent stigma on the drupelet surface. Image by T. Vieira.

Type: Brazil, Bahia: Barro Preto, 'Serra da Pedra Lascada, 13.7 km de Barro Preto, na estrada que passa pela fazenda São Miguel e sobe até o acesso à Serra, caminhada até o topo da Serra', 2 Nov. 2003 (staminate flower), Fiaschi, P. 1818 et al. (holotype: CEPEC 97630; isotype: NY 01282051[photo]).

Description

Shrub, 2–3 m tall, dioecious, twigs cylindrical, brownish when dried, nodes thickened, striated, pilose to glabrescent. Trichomes acicular, deciduous, 1–4 mm long. Cataphylls ensiform 1.3–2.4 × 0.3–0.4 cm, apex acute, glabrous on ventral face and sericeous to glabrescent on dorsal face. Leaves 15.0–30.3 × 3.5–12.4 cm, elliptical, rarely oblanceolate, base cuneate, apex acute or occasionally narrowly acuminate, 10–25 teeth, patent on 2/3 apical, inconspicuous to absent on 1/3 basal, leaves olive to brown-green when dried on adaxial face and paler on abaxial face, chartaceous, adaxial face pilose to glabrescent, often with scars left by detached trichomes, abaxial face pilose, trichomes line on primary veins and at the margin, secondary veins 6–8 pairs, immersed on adaxial face and prominent on abaxial face. Petiole 0.5–2.1 cm long, canaliculate, pilose. Staminate flowers 8–14 mm × 5–9 mm, in 1–2 cymes (three-florous), terminal or axillar, white-yellowish sericeous to pilose, peduncle 8–21 mm long, pilose, pedicel 1–3 mm long, bracts falcate 9–14 × 1–4 mm, apex acute, receptacle cupuliform. Tepals ca $\frac{3}{4}$ of the entire flower length, external tepals orbicular, ca 0.7 × 6.0 mm, internal tepals elliptic toothed, ca 6 × 4 mm, stamens 41–53, filaments ca 1/5 of anthers length, anthers 1.9–2.8 × 0.9–1.1 mm, oblong, dehiscent by longitudinal slits connected over the apex. Pistillate flowers unknown. Drupelets 2–11, ellipsoid, 7–7 × 5–10 mm, base and apex acute, stigma persistent, pilose when immature, glabrescent when mature, brown or olive when dried, green when fresh (mature fruits not observed fresh), pericarp hard, fruiting receptacle 7–13

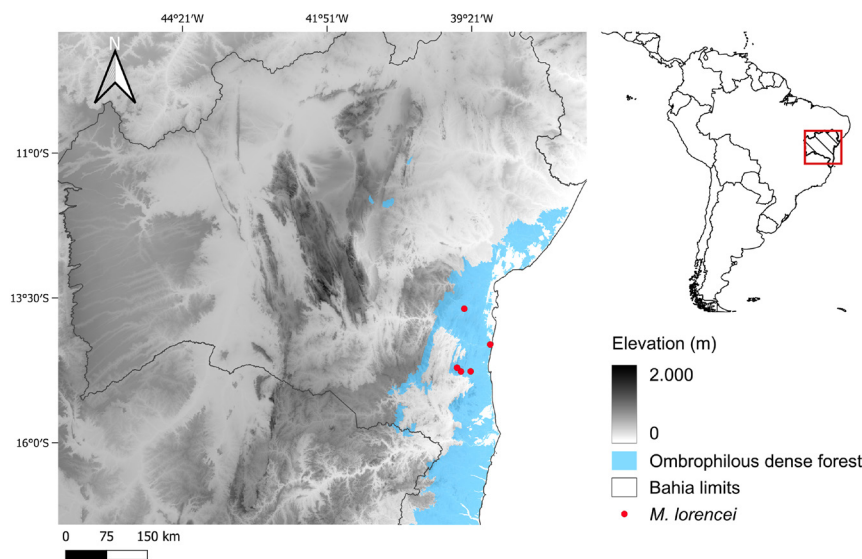


Figure 3. Geographical distribution of *Mollinedia lorencei* sp. nov., represented by red dots, within Bahia state.

Table 1. Comparison of characters among *Mollinedia lorencei* with the similar species *M. dolichotricha* Lirio & Peixoto and *M. lamprophylla* Perkins. Characters of *M. dolichotricha* and *M. lamprophylla* were based on Perkins 1900, Peixoto 1979, Lirio and Peixoto 2015, 2017 and Lirio et al. 2020b.

Species	<i>M. lorencei</i>	<i>M. dolichotricha</i>	<i>M. lamprophylla</i>
Habit	shrub, 2–3 m tall	tree, 5–14 m tall	shrub or tree, 3–10 m tall
Indument	twigs pilose to glabrescent leaves pilose to glabrescent on adaxial face, abaxial face pilose, trichomes line on primary veins and at the margin	twigs pilose to glabrescent leaves glabrescent on adaxial face and pilose on abaxial face, mainly on the primary and secondary veins	twigs tomentose to glabrescent leaves glabrous on adaxial face, abaxial face tomentose, primary veins and margin with a line of trichomes
Leaves	15.0–30.3 × 3.5–12.4 cm, elliptical (rarely oblanceolate), base cuneate, apex acute (occasionally narrowly acuminate), olive to green-brown when dried	7.0–12.0 × 2.2–4.0 cm, oblong to elliptical, base cuneate (rarely acute), apex attenuate or acuminate, brown when dried	14.7–30.5 × 5.1–12.7 cm, elliptical or obovate, base obtuse (rare rounded), apex acute, yellow-greenish when dried
Secondary veins	6–8 pairs	4–5 pairs	8–14 pairs
Leaves margin	10–25 teeth, inconspicuous to absent on 1/3 basal, patent on 2/3 apical	entire or with 1–2 teeth on the 1/3 apical (up to nine teeth in young individuals)	14–60 inconspicuous teeth on the 2/3 apical
Staminate flowers	1–2 cymes (three-florous), terminal or axillar, sericeous to pilose bracts lanceolate, falcate, apex acute receptacle cupuliform	thyrsus 2–4 cymes (three-florous), terminal, pilose bracts deltoide, apex acute receptacle campanulate	thyrses 3–6 cymes (three-florous), terminal, tomentose bracts oblong, apex acute receptacle almost plane
Stamens	stamens 41–53, filaments ca 1/5 of anthers length	stamens 18–24, sessile	stamens (40–)80–82, filaments null
Drupelets	ellipsoid, 0.7–1.7 × 0.5–1.0 cm, apex acute pilose when immature, then glabrescent	elliptical, 1.8–2.3 × 1.3 cm, apex acute pilose when immature, then glabrescent	elliptical or oblongs, 1.5–3.0 × 0.9–1.9 cm, apex acute velutinous when immature, then glabrescent
Distribution	BA	BA, ES, MG	BA, ES, MG, RJ, SP

mm wide, reflexed, pilose, fruit scars prominent, peduncle 6–12 mm long.

Additional specimens examined (paratypes)

Brazil, Bahia: Almadina, 'Serra do Corcovado. 9.8 km ao SW de Coarací na estrada para Almadina, daí N até a fazenda São José, Proprietário Senhor Francisco, meio da encosta', 650–870 m a.s.l., 4 Oct. 2006, Lopes M. M. M. 1118 et al. (CEPEC 114511; NY 1419238[photo]); Barro Preto, 'Serra da Pedra Lascada, Floresta Ombrófila Densa Montana', 770 m a.s.l., 6 Mar. 2018, Vieira, T. L. 368 et al. (HUEFS 258661); Almadina, 'Serra do Corcovado. 13.8 km ao SW de Coarací na estrada para Almadina, Fazenda São José, Proprietário Senhor Francisco, floresta ombrófila Densa Montana', 650–900 m a.s.l., 12 Aug. 2007, Cardoso, D. 2147 et al. (CEPEC 117688); Itacaré, 'rodovia Itacaré/Taboquinhas entrada a 6 km de Itacaré, loteamento da Marambaia, mata higrófila sul baiana', 16 July 1995, Jardim, J. G. 655 et al. (CEPEC 65984); Wenceslau Guimarães, 'Estação Ecológica, trilha da fazenda três praças para a Estação Ecológica', 535 m a.s.l., 26 Nov. 2013, Aona, L. Y. S. 3444 et al. (HURB 7661).

Etymology

The specific epithet is a tribute to Dr David Harold Lorence of the National Tropical Botanical Garden, who has dedicated his academic career to the study of the systematics and floristics of tropical vascular plants, especially focusing on Rubiaceae and Monimiaceae. D. H. Lorence has published

numerous studies on Monimiaceae, including new species of *Mollinedia*.

Distribution and habitat

Mollinedia lorencei occurs in the state of Bahia (BA), within the Atlantic Forest at elevations ranging from 100–900 m a.s.l. (Fig. 3). The species is known to occur in areas characterized by the af climatic type (tropical rainforest climate) according to the Köppen–Geiger classification (Kottek et al. 2006).

Phenology

The species has been collected with staminate flowers in October and November, and with fruits through March, July, August and November.

Conservation status

Mollinedia lorencei has an extent of occurrence (EOO) of 4046.307 km² and an area of occupancy (AOO) of 20 km². Specimens have been collected from four sites (Serra do Corcovado, Almadina – BA; Serra da Pedra Lascada, Barro Preto – BA; Itacaré – BA and Wenceslau Guimarães – BA), which have been threatened by agricultural expansion, hence there are four locations for the species. According to IUCN categories and criteria (2012, 2022), *M. lorencei* can be preliminarily categorized as EN B1ab(iii) + 2ab(iii), because of the small EOO and AOO (< 5000 and < 500 km², respectively), the number of locations (< 5), and a continued decline in

area and habitat quality. Between 1985 and 2021, there was a reduction of 4.4% in forest coverage within the EOO of the species; in the same period, there was a 49% increase in pastures within the same area, occupying 13.9% of the EOO of *M. lorencei* by 2021 (Projeto MapBiomias 2023). Moreover, *M. lorencei* is not known to occur in protected areas; however, the register from Wenceslau Guimarães, state of Bahia is near the Wenceslau Guimarães Ecological Station (ESEC); thus, it is plausible that the species can be found in this protected area.

Discussion

The new species resembles *M. dolichotricha* due to its long and patent trichomes and *M. lamprophylla* due to its leaf shape and trichomes line at the margin. In Table 1, we provide a summarized comparison between the three species based on herbaria vouchers and bibliography.

The Atlantic Forest is the diversity center of Monimiaceae, apportioning new species of *Mollinedia* year by year, as *M. ruschii* Lírío & Peixoto (Lírío et al. 2020b), *M. leucantha* M.Molz. & D.Silveira (Molz and Silveira 2021) and *M. arianae* (Lírío et al. 2023), all endemic to this biome. Considering the description of *Mollinedia lorencei*, the number of species within the genus in the Atlantic Forest increases to 34, with 31 being endemic to the biome (Lírío et al. 2020b). This reinforces the position of Atlantic Forest as the biome with the highest number of species within the genus, when compared to other Brazilian biomes. The Amazon Forest has four species of *Mollinedia*, the Cerrado has three species, the Caatinga one species and Pantanal one species (Lírío et al. 2020b).

The Atlantic Forest retains only 11.73% of its original vegetation, and it is highly fragmented, with 83.4% of its fragments being smaller than 50 hectares (Ribeiro et al. 2009). This biome is considered a global biodiversity hotspot (Myers et al. 2000) and is protected by Law no. 11 428 (Brasil 2006). However, it remains subject to deforestation. Between 2021 and 2022, in the state of Bahia alone, 5719 ha of forest were deforested (Fundação SOS Mata Atlântica and INPE 2023). The effort to detect new species is essential for a better understanding of the flora composition of the biome, and can contribute to its valuation and conservation, especially for microendemic species, which are more likely to be threatened (Silva et al. 2019).

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Author contributions

Lucas Borges de Lima: Data curation (equal); Formal analysis (lead); Investigation (lead); Project administration (equal);

Validation (equal); Writing – original draft (lead). **Danilo Alvarenga Zavatin:** Formal analysis (equal); Investigation (equal); Methodology (equal); Project administration (equal); Writing – original draft (equal). **Ariane Luna Peixoto:** Conceptualization (equal); Resources (equal); Supervision (supporting); Writing – review and editing (equal). **Paulo Takeo Sano:** Funding acquisition (equal); Supervision (supporting); Writing – review and editing (equal). **Elton John de Lírío:** Conceptualization (lead); Methodology (lead); Project administration (equal); Supervision (lead); Validation (equal); Writing – review and editing (lead).

Data availability statement

There are no additional data for this paper.

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