

# *Mollinedia ruschii* (Monimiaceae, Mollinedioideae), a new Critically Endangered species microendemic to the Atlantic rainforest, eastern Brazil

Elton John de Lirio<sup>1,\*</sup>, Raquel Negrão<sup>2</sup>, Paulo Takeo Sano<sup>1</sup> & Ariane Luna Peixoto<sup>3</sup>

<sup>1</sup>Departamento de Botânica, Instituto de Biociências, Universidade de São Paulo. Rua do Matão 277, Edifício Sobre-as-ondas (Herbário) 05508-090, São Paulo, SP, Brazil

<sup>2</sup>Conservation Science Department, Royal Botanic Gardens, Kew, Richmond, TW9 3AE, UK

<sup>3</sup>Instituto de Pesquisas Jardim Botânico do Rio de Janeiro, Rua Pacheco Leão, 915, Jardim Botânico, 22460-030, Rio de Janeiro, RJ, Brazil

\*Corresponding author: [lirioeltonj@gmail.com](mailto:lirioeltonj@gmail.com)

**Background** – Studies of neotropical Monimiaceae revealed a new species of *Mollinedia* endemic to the state of Espírito Santo, eastern Brazil. In this study, we describe, illustrate, and compare the new species with related taxa. In addition, ecological comments and extinction risk assessment of the new species are provided.

**Methods** – This study was based on herbarium material and field work observations. The risk of extinction assessment follows the IUCN Red List of Threatened Species' Criteria and Categories and the latest version of the IUCN Guidelines.

**Results** – *Mollinedia ruschii* sp. nov. has habitat specificity with few individuals recorded, mainly in the Estação Biológica de Santa Lúcia, a protected area created by Augusto Ruschi, a Brazilian naturalist and researcher, to whom we dedicate the name of the new species. Phytosociological and forest dynamics studies and intensive field work in the area where the species occurs, enabled the detection of the decline of mature individuals in previous decades. Following the IUCN Red List criteria, the species is assessed as Critically Endangered.

**Keywords** – Flora of Brazil; Flora of Espírito Santo; IUCN red list; Laurales; Mollinedieae; narrow endemic; species decline; threatened species.

## INTRODUCTION

*Mollinedia* Ruiz & Pavón (1794) is the most species-rich neotropical genus of Monimiaceae, a pantropical family with ca 28 genera and 200 species (Renner et al. 2010; Flora do Brasil 2020). *Mollinedia* has ca 60 species, occurring from southern Mexico to Central and tropical South America (Lorence 2011; BFG 2015; Lirio & Peixoto 2017; Flora do Brasil 2020). The genus was described by Ruiz & Pavón (1794) based on three species from Peru. Later, Perkins (1898) included the genus in the tribe Mollinedieae (along with *Macrotorus* Perkins and *Macropeplus* Perkins), which is characterized by pistillate flowers with a circumscissile

receptacle apex. This classification was accepted by later researchers (Philipson 1987, 1993; Peixoto & Pereira-Moura 2008; Lirio et al. 2015).

*Mollinedia* is characterized by staminate flowers with buds almost round, perianth lobes with a ratio of ca 1:1 in relation to the length of the receptacle, and stamens ovate or rounded, the locules either with two longitudinal openings and an extended connective or confluent at the apex, making the anthers horseshoe-shaped (Perkins 1898, 1900). Although *Mollinedia* is morphologically well circumscribed, molecular studies do not support the monophyly of this genus (Renner et al. 2010). However, phylogenetic studies with

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*Plant Ecology and Evolution* is published by Meise Botanic Garden and Royal Botanical Society of Belgium  
ISSN: 2032-3913 (print) – 2032-3921 (online)

more data and more taxa are still needed. Thirty-six species of *Mollinedia* occur in Brazil, most of them in the Brazilian Atlantic rainforest, and most abundant in the states of Bahia, Espírito Santo, Rio de Janeiro, and São Paulo (BFG 2015; Lírio & Peixoto 2017).

In the state of Espírito Santo, three genera and 21 species of Monimiaceae are recorded. The municipality of Santa Teresa is the richest area of the state with 19 species (Lírio & Peixoto 2017). This area is also rich in species of several other plant groups and several new species have been described in recent years (e.g. Bünger et al. 2016; Goldenberg & Kollmann 2016; Oliveira et al. 2016; Alves-Araújo & Mônico 2017; Moraes & Vergne 2017; Sobral et al. 2017; Trad et al. 2018; Flores et al. 2019).

In the present work, we describe and illustrate *Mollinedia ruschii*, a new species endemic to Espírito Santo state, eastern Brazil. We also assess the conservation status of the new species according to the IUCN Red List of Threatened Species (hereafter referred to as IUCN Red List) and discuss the relationship to the morphologically similar species *Mollinedia stenophylla* Perkins (Perkins 1900) and *Mollinedia boracensis* Peixoto (Peixoto 1983).

#### MATERIAL AND METHODS

Morphological terms follow Harris & Harris (2001), except for hair terminology, which follows Payne (1978), and that of characters unique to Monimiaceae, which are described according to Perkins (1898, 1900). Descriptions and measurements are based on dry herbarium specimens. Herbaria acronyms follow Thiers (continuously updated), and nomenclature follows the latest ICBN (Turland et al. 2018). The diagnosis and table of characters for related species were based on herbaria material. The examined material for *M. boracensis* and *M. stenophylla* is available in supplementary file 1.

The ecological and conservation data were collected through field observations, collections deposited in herbaria and phytosociological studies (Thomaz & Monteiro 1997; Saiter et al. 2011; Saiter & Thomaz 2014; Eduardo F. Oza pers. comm. 2019). The extinction risk assessment follows the IUCN Red List of Threatened Species Categories and Criteria (IUCN 2012) and the Guidelines for Using the IUCN Red List Categories and Criteria (IUCN 2019). The area of occupancy (AOO) and extent of occurrence (EOO) were calculated with the Geospatial Conservation Assessment Tool - GeoCAT (Bachman et al. 2011).

#### RESULTS

***Mollinedia ruschii*** Lírio & Peixoto, **sp. nov.** (figs 1–3, table 1) – Type: BRAZIL • Espírito Santo state, Municipality of Santa Teresa, Estação Biológica Santa Lúcia, Sagui trail, after the beginning of Indaiáçu trail, before the peak [“Trilha do Sagui, após encontro com trilha do Indaiáçu, antes de chegar ao topo”]; 19°58'17.6"S, 40°32'05.0"W; 1 Aug. 2018; staminate fl.; *E.J. Lírio & M.R. Neto 1548*; holotype: SPF;

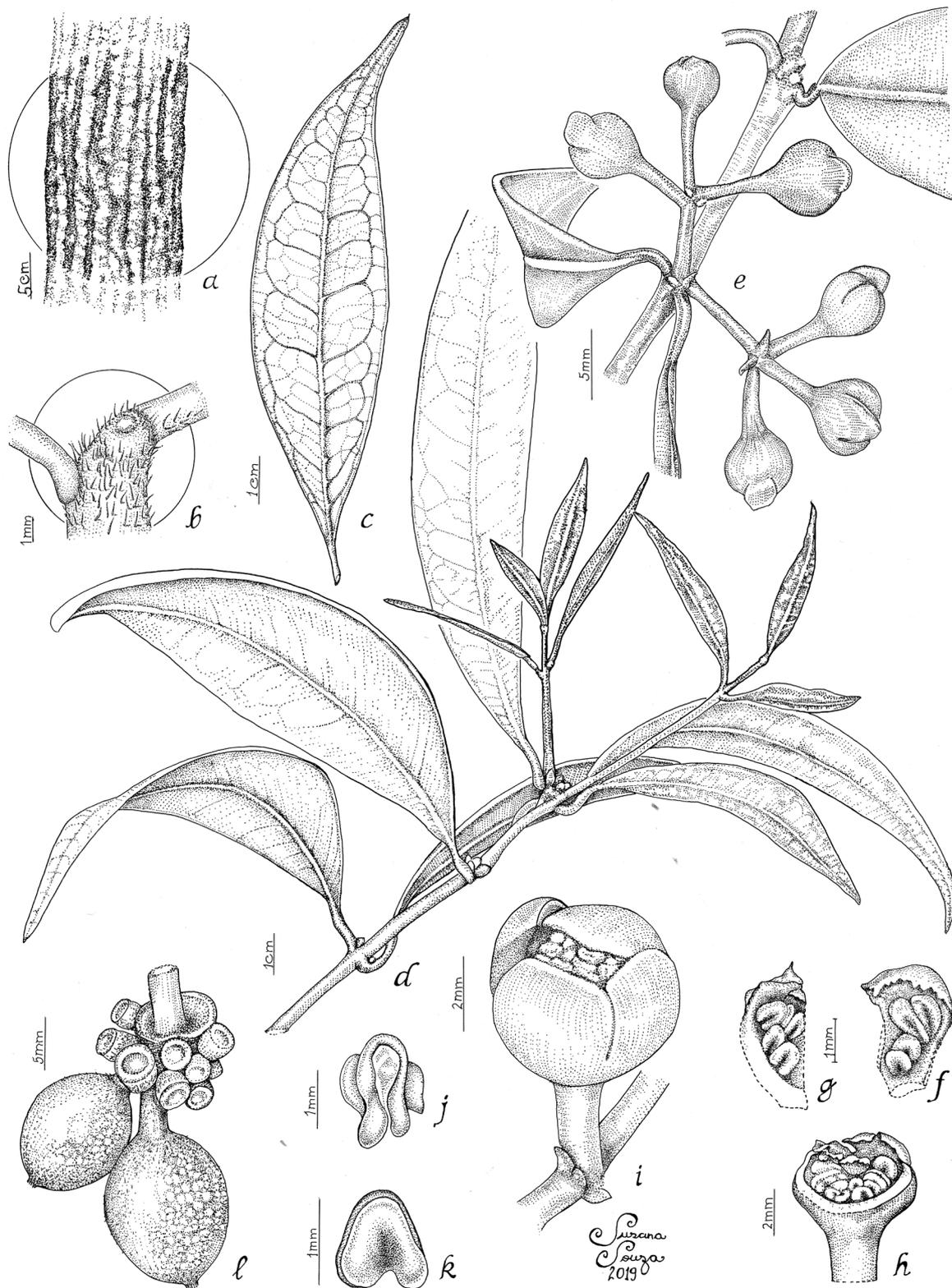
isotypes: MBML, SPF, 3 duplicates to be distributed to P, NY, and K.

**Diagnosis** – *Mollinedia ruschii* is morphologically similar to *M. stenophylla*, however, it is easily distinguished by its tree habit 3–15 m tall, corky bark, leaves and branchlets reddish when young, leaves opposite, entire or 1–2-teethed, odoriferous when fresh, staminate flowers with reddish pedicel, tepals 2/3 of the length of the flower, bracts and bracteoles ca 1 mm, ovate, drupelets 0.8–2.0 × ca 1.2 cm, glabrous, fruiting receptacle with prominent scars (vs shrub habit up to 1 m tall, bark not corky, young branchlets green, leaves ternate and opposite on the same branch, 3–12-teethed, without odour when fresh, staminate flowers with yellowish pedicel, tepals 1/2 of the length of the flower, bracts and bracteoles ca 1.5 mm long, lanceolate, drupelets ca 0.8 × 0.6 cm, strigose, fruiting receptacle without prominent scars in *M. stenophylla*). *Mollinedia ruschii* is also morphologically similar to *M. boracensis*, but it can be easily distinguished by its leaves with attenuate apex, 9–13 pairs of secondary veins, rachis in staminate flowers 0.2–1.1 cm long, tepals ca 2/3 of the flower length and 12–15 stamens (vs leaves with acute apex, 5–6 pairs of secondary veins, rachis in staminate flowers with 4–7 cm, tepals ca 1/2 of the flower length, and 22–24 stamens in *M. boracensis*).

**Description** – **Trees** 3–15 m tall, dbh 10–21 cm, dioecious, rhytidome corky, longitudinally cracked, canopy sparse, twigs cylindrical, green or greyish when fresh, brownish or black when dried, striated, glabrous, nodes thickened, young branches glabrate and reddish. **Leaves** 6.5–13.5 × 1.2–3.8 cm, opposite, blade oblong to elliptical, base cuneate, rare acute, apex attenuate, frequently falcate, entire or with 1–2 teeth, when fresh dark green on adaxial face and light green on abaxial face, aromatic, when dry brown on adaxial face and paler on abaxial face, subleathery, glabrous, opaque, pellucid punctuated, secondary veins 9–13 pairs, immersed on adaxial face and prominent on abaxial face, petiole 0.6–1.8 cm long, canaliculate, glabrous. **Staminate flowers** yellow, in cymose thyrses with 1–6 cymes (3-florous), axillary or terminal, white-strigillose, rachis 0.2–1.1 cm long, peduncle 0.4–1.4 cm long, reddish, pedicel 0.2–1.3 cm long, reddish, bracts ovate, apex acute, 0.7–0.8 mm long, bracteoles ovate, apex acute, 1–1.5 mm long, receptacle campanulate, 5–6 × ca 5 mm, tepals 2/3 of the flower length, two external shorter, margin irregular, the two internal unequal, one with fimbriate appendix, the other with denticulate appendix, stamens 12–15, hippocrepiform, sessile, anthers dehiscent by longitudinal slits. **Pistillate flowers** not seen. **Drupelets** early exposed, 1–3(–14), ellipsoid or orbicular, 0.8–2 × ca 1.2 cm, not stipitate, base rounded or obtuse, apex obtuse, stigma persistent, glabrous, brown when dry, pericarp hard, rugose, fruiting receptacle 0.5–1 cm wide, reflexed, glabrous, brown when dry, fruit scars prominent, peduncle plus pedicel 0.9–2.5 cm long. Figures 1, 2.

**Distribution** – The species only occurs in the municipality of Santa Teresa, state of Espírito Santo, eastern Brazil, in the Estação Biológica de Santa Lúcia and the Reserva Biológica Augusto Ruschi (fig. 3).

**Habitat** – *Mollinedia ruschii* occurs in montane ombrophilous phytophysiognomy in the Atlantic forest,



**Figure 1** – *Mollinedia ruschii*. A. Trunk. B. Branch detail showing trichomes. C. Leaf showing venation. D. Branch. E. Staminate inflorescence. F. Dissected staminate flower showing internal tepal. G. Dissected staminate flower showing external tepal. H. Staminate flower receptacle showing stamens. I. Staminate flower in detail. J. Dehiscent stamens. K. Stamens in frontal view. L. Fruiting receptacle with drupelets. A, C, D, E, & I from E.J. Lirio & M.R. Neto 1548 (MBML); B from L.D. Thomaz 1656 (RB); F, G, H, J, & K from E.J. Lirio & V.L. Aledi 20 (RB); and L from L.J. Kollmann 2302 (RB). Drawing by Susana Sousa.

between 750 and 850 m elevation. The microendemism of *M. ruschii* is probably due to a climatic tolerance to a narrow set of environmental conditions, specific to the humid montane forests of the municipality of Santa Teresa, Espírito Santo state.

**Phenology** – The species has been collected with flowers from May through September, and with fruits in January through March, May, and August.

**Etymology** – The specific epithet honours the Brazilian naturalist Augusto Ruschi (1915–1986) who created the

Museu de Biologia Mello Leitão, a research institution dedicated to study the Atlantic forest (now referred to as Instituto Nacional da Mata Atlântica). The Estação Biológica de Santa Lúcia belongs to the Instituto Nacional da Mata Atlântica, the Universidade Federal do Rio de Janeiro, and the Associação de Amigos do Museu Nacional and is managed by the Instituto Nacional da Mata Atlântica. Augusto Ruschi contributed greatly to the conservation of Brazilian forests, especially in the Espírito Santo state. Due to his recognition as a naturalist and political influence, Ruschi participated in

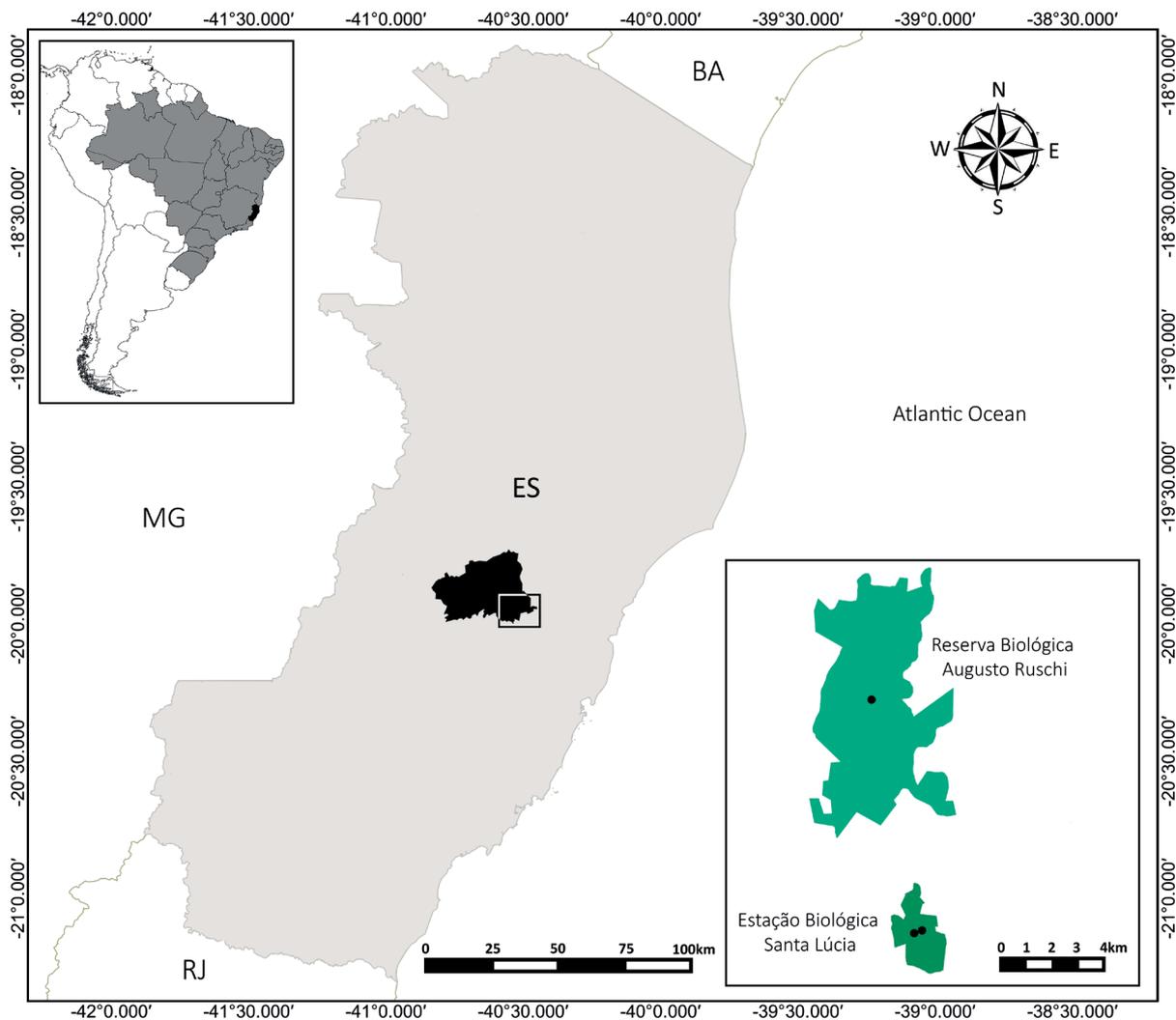


**Figure 2** – *Mollinedia ruschii*. A. Trunk. B. Young branch. C. Branch with staminate flowers. D. Detail of staminate inflorescence. E. Fruiting receptacle with drupelets. A–D from E.J. Lírio & M.R. Neto 1548; E from L.J. Kollmann 2302 (RB). Photographs by Elton J. de Lírio.

the process of conceptualization and demarcation of seven conservation units (UCs) in Espírito Santo, including the Reserva Biológica Nova Lombardia, nowadays renamed to Reserva Biológica Augusto Ruschi (Dean 2004; Gonçalves 2019). The two areas where *Mollinedia ruschii* occurs, the Estação Biológica de Santa Lúcia and the Reserva Biológica Augusto Ruschi, are preserved today in part due to the influence of Augusto Ruschi (Dean 2004; Gonçalves 2019).

**IUCN conservation assessment (provisional)** – *Mollinedia ruschii* is endemic to Espírito Santo state, eastern Brazil, known only from two relatively small protected areas (Estação Biológica de Santa Lúcia and the Reserva Biológica Augusto Ruschi) with different levels of protection and management. The forest patches are embedded in a farming matrix, fragmented by agriculture, wood plantations (especially *Eucalyptus* spp.), and residential areas. Its extent of occurrence (EOO) is estimated at 8 km<sup>2</sup>, and considering that the convex hull formed by the points is smaller than the area of occupancy (AOO), estimated at 8 km<sup>2</sup>, it falls within the Critically Endangered category. The species is considered to have one location, since the mature individuals

were recorded solely in two nearby sites, however, only one of those sites is a federal protected area with a management plan and surveillance (Biological Reserve Augusto Ruschi). A single event caused by fire, disease, or anthropic action at the second site (Estação Biológica de Santa Lúcia) could bring the species close to the extinction, considering potential lack of protection, resources, or delays in response caused by the need of concerted action by institutes from different sectors. The Estação Biológica de Santa Lúcia is owned by the Instituto Nacional da Mata Atlântica, linked to the Ministry of Science, Technology and Innovations, and by the Associação de Amigos do Museu Nacional, which is part of the nonprofit sector. The area is currently not surveyed, and the habitat of this species has suffered continuing decline and fragmentation, mainly due to urban expansion, agriculture, and livestock farming. The wood plantation of *Eucalyptus* expanded during the last decade in Santa Teresa (IBGE 2006, 2017) and pastureland represent ca 12% of the municipality area (LAPIG 2020). The increased frequency of drought and fire (Fraga et al. 2019) are also important threats to this species, which cannot be properly managed without



**Figure 3** – Geographical distribution of *Mollinedia ruschii*, represented by black dots. The municipality of Santa Teresa is represented by the black shape. ES = Espírito Santo state; MG = Minas Gerais state; RJ = Rio de Janeiro state; BA = Bahia state.

**Table 1** – Comparison of *Mollinedia ruschii* with the morphologically similar species *M. boracensis* and *M. stenophylla*.

Species	<i>M. ruschii</i>	<i>M. stenophylla</i>	<i>M. boracensis</i>
<b>Habit and habitat</b>	tree 4–15 m, bark corky, on hilltops	shrub up to 1 m, bark not corky, on river margins	tree 3.5–12 m, bark not corky, on hilltops
<b>Young branches</b>	reddish	green	unknown
<b>Leaves</b>	opposite, entire or 1–2-teethed	ternate and opposite on the same branch, 3–12-teethed	opposite, entire or up to 12-teethed
<b>Staminate flowers</b>	tepals 2/3 of the flower length, bracts and bracteoles ca 1 mm, ovate, 12–15 stamens	tepals 1/2 of the flower length, bracts and bracteoles ca 1.5 mm, lanceolate, 13–15 stamens	tepals ca 2/3 of the flower length, bracts and bracteoles ca 2 mm, ovate, 22–24 stamens
<b>Drupelets</b>	0.8–2.0 × 1.2 cm, glabrous, fruiting receptacle with prominent scars	ca 0.8 × 0.6 cm, strigose, fruiting receptacle without prominent scars	1.6–1.8 × 1.2–1.4 cm, glabrescent, fruiting receptacle with prominent scars
<b>Geographic distribution</b>	Espírito Santo state, Brazil	Rio de Janeiro state, Brazil	São Paulo state and Rio de Janeiro state, Brazil

a management plan. Also, considering that the species is dioecious, the potential loss of pollinators represents an incident threat, because several species of invertebrates in the state of Espírito Santo have been assessed as threatened (Fraga et al. 2019).

*Mollinedia ruschii* is known from no more than 12 collections in a well-collected region, and it currently comprises only three known male mature individuals, with no female individuals recently found. There is a growing concern about the mortality of adult individuals of this species within the Estação Biológica Santa Lúcia. For example, a floristic and phytosociological study conducted in the Estação Biológica Santa Lúcia in 1997 using plots (1.2 ha) found only four mature individuals of the species (Thomaz & Monteiro 1997). In later studies (Saiter et al. 2011; Saiter & Thomaz 2014; Eduardo F. Oza, pers. comm. 2019) on forest dynamics in the same area, three individuals of *M. ruschii* were found dead and no new individuals of this species were sampled. An intensive fieldwork was carried out between 2011 and 2018 by one of the authors (EJL), including targeted searches for individuals previously collected (e.g. *Kollmann 2302*, *Demuner 599*, and *Vervloet 1936*) and potential habitats with the same altitudinal range and vegetational type. Those specimens were not found during the searches and they are likely to be dead. An individual from those sampled by Thomaz & Monteiro (1997) was also found dead. Pistillate individuals of this species were last seen in 2003 (*Vervloet 1936*). We also found only two young individuals in the localities where the species occurs (in Estação Biológica Santa Lúcia), which suggests that the species can reproduce but in very low numbers. We therefore estimate the total number of mature individuals to be less than 50 mature individuals.

The species present a restricted distribution in terms of extent of occurrence (EOO) and area of occupancy (AOO), however, based on the different levels of protection and management between the two protected areas where this species occurs, it is likely to have two different locations, falling into the Endangered category. Thus, based on the precautionary principle, this species is assessed as Critically Endangered (CR C2a(i); D), considering an inferred continuing decline (especially in terms of the number of

locations and mature individuals), combined with a very small population size represented by a low number of mature individuals in each subpopulation.

**Additional material examined (paratypes)** – BRAZIL – Espírito Santo: Santa Teresa • Estação Biológica de Santa Lúcia; 3 Jul. 2004; male fl.; *Kollmann 6916*; RB • Estação Biológica de Santa Lúcia, Mata Atlântica de encosta, A3P15N442; 14 Apr. 1994; fr.; *Thomaz 1145*; HRCB, MBML, RB, RBR • Estação Biológica de Santa Lúcia, Parcela 14; 13 Jan. 1994; fr.; *Thomaz 1656*; MBML, RB • Estação Biológica de Santa Lúcia, A3P17N473; 1 Aug. 1993; male fl.; *Thomaz 1657*; MBML, RB • Estação Biológica de Santa Lúcia, trilha do sagui; 30 Mar. 1999; fr.; *Kollmann et al. 2302*; MBML, RB • Estação Biológica de Santa Lúcia, trilha do sagui, A3P20N589 de L. Thomaz; 2 Aug. 2011; male fl.; *Kollmann & Bausen 4251*; MBML, RB • Estação Biológica de Santa Lúcia, trilha do sagui, topo do morro; 15 Sep. 2012; male fl.; *Lírio 169*; RB • Estação Biológica de Santa Lúcia, A3P17N473 de Luciana Thomaz; 28 Jun. 2011; male fl.; *Lírio & Aledi 20*; MBML, RB • Estação Biológica de Santa Lúcia; 30 Jul. 2011; male fl.; *Lírio & Aledi 37*; MBML, RB • Estação Biológica de Santa Lúcia, final da trilha do Indanhaçu; 25 Jan. 2000; fr.; *Demuner & Bausen 599*; MBML, RB • trilha da Pinguela; 27 May 1999; male fl.; *Lopes et al. 767*; MBML, RB • Nova Lombardia, Reserva Biológica Augusto Ruschi; 6 Mar. 2003; fr.; *Vervloet et al. 1936*; MBML, RB.

## DISCUSSION

*Mollinedia* has not been recovered as monophyletic in molecular studies, due to the presence of *Grazielanthus arkeocarpus* Peixoto & Per-Moura and *Macrotorus utriculatus* (Mart ex Tul.) Perkins among the *Mollinedia* species (Renner et al. 2010). However, more robust data and sampling is necessary to resolve the relationships between these genera. Even if further studies confirm the polyphyly of *Mollinedia*, this genus has priority and the new species proposed here will remain unchanged.

*Mollinedia ruschii* is morphologically similar to *M. stenophylla* in shape, colour, consistency and surface of the leaves, and the number and shape of the stamens. It is

also similar to *M. boracensis* in the shape and consistency of leaves and the receptacle shape of the flower. The species differs from *M. stenophylla* and *M. boracensis* in the characters presented in the diagnosis and in table 1. This set of characters was considered important for the recognition of species in the genus *Mollinedia* by different authors (Peixoto 1979; Lorence 1999, 2011; Lirio & Peixoto 2015; Molz & Silveira in press). *Mollinedia ruschii* also differs from *M. boracensis* and *M. stenophylla* in geographic distribution and habitat. While *M. boracensis* occurs in the state of São Paulo and Rio de Janeiro, *M. stenophylla* and *M. ruschii* have a very specific habitat (Lirio et al. 2018, 2020). *Mollinedia stenophylla*, recently rediscovered after 112 years without collections, occurs only on the banks of the Macaé River in the municipality of Nova Friburgo, in the state of Rio de Janeiro (Lirio et al. 2018). *Mollinedia ruschii* is also a microendemic species, restricted to the montane forests between 750 and 850 m elevation in Santa Teresa, Espírito Santo. Microendemic species are expected to be more sensitive to climate change and more susceptible to extinction due to the restricted range and habitat specificity (Bitencourt et al. 2016). There is a general concern in plant conservation regarding the best strategies to conserve microendemism. Potential strategies include research into artificial propagation, ecophysiology, pollination seed dispersal, phenology, genetic diversity, monitoring, modelling of potential distribution, threat mitigation, reintroduction, and ex situ conservation (Martins et al. 2014; Zhang et al. 2014; Kraaij et al. 2016).

We can affirm that Ruschi's efforts to create those protected areas in Espírito Santo were fundamental for conserving this rare tree species. Currently, the habitat protection has guaranteed the species presence (assessed as Critically Endangered, with less than 50 individuals), however, a single change in the legislation could drive the taxon to extinction in a very short time. We highlight the importance of retaining the site's protection, as well as the need for more ecological and population studies to support focused conservation actions for endemic species in these areas, including efforts to organise seed collection and propagation.

#### SUPPLEMENTARY FILE

**Supplementary file 1** – Selected herbarium specimens of *Mollinedia stenophylla* Perkins and *Mollinedia boracensis* Peixoto analysed for this study.

<https://doi.org/10.5091/plecevo.2021.1741.2371>

#### ACKNOWLEDGEMENTS

The authors thank the curators of the herbaria consulted (MBML, RB, RBR, SPF, VIES, SAMES, CVRD), the National Geographic Society (Grant #EC-350C-18) and the National Council for Scientific and Technological Development (Conselho Nacional de Desenvolvimento Científico e Tecnológico – (CNPq) Proc. 437106/2018-7) for their financial support; Moacir R. Neto for his support in field collections, Dr Felipe Z. Saiter and Eduardo F. Oza for the information about the species in their phytosociological

study, Joelcio Freitas for the map and Susana F. Souza for the line drawing. We also thank Dr Alyne S. Gonçalves, Dr Brecht Verstraete, Dr David Lorence, Dr Steve Bachman, the Editors for IUCN Conservation assessments and the anonymous reviewer for suggestions in the manuscript and Vanessa Taylor for the English revision. E.J.L. thanks CNPq (Proc. #153129/2018-2) for the fellowship. P.T.S. thanks CNPq fellowship (Proc. #310331/2019-6).

#### REFERENCES

- Alves-Araújo A. & Mônico A.Z. 2017. *Pouteria samborae*, a new species of Sapotaceae (Chrysophylloideae) from Espírito Santo, Brazil. *Systematic Botany* 42(2): 358–363. <https://doi.org/10.1600/036364417X695501>
- Bachman S., Moat J., Hill A.W., de la Torre J. & Scott B. 2011. Supporting Red List threat assessments with GeoCAT: geospatial conservation assessment tool. In: Smith V. & Penev L. (eds) e-infrastructures for data publishing in biodiversity science. *ZooKeys* 150: 117–126. <https://doi.org/10.3897/zookeys.150.2109>
- BFG – The Brazilian Flora Group 2015. Growing knowledge: an overview of seed plant diversity in Brazil. *Rodriguésia* 66(4): 1085–1113. <https://doi.org/10.1590/2175-7860201566411>
- Bitencourt C., Rapini A., Damascena L.S. & Junior P.M. 2016. The worrying future of the endemic flora of a tropical mountain range under climate change. *Flora - Morphology, Distribution, Functional Ecology of Plants* 218: 1–10. <https://doi.org/10.1016/j.flora.2015.11.001>
- Bünger M.O., Mazine F.F. & Stehmann J.R. 2016. *Eugenia ruschiana* (Myrtaceae), a new species from southeastern Brazilian Atlantic forest. *Phytotaxa* 266(1): 40–44. <https://doi.org/10.11646/phytotaxa.266.1.6>
- Dean W. 2004. A ferro e fogo: a história e a devastação da Mata Atlântica brasileira. First edition. Companhia das Letras, São Paulo.
- Flora do Brasil 2020. Jardim Botânico do Rio de Janeiro. Available from <http://floradobrasil.jbrj.gov.br> [accessed 26 Aug. 2020].
- Flores T.B., Sobral M., Valdemarin K.S. & Souza V.C. 2019. *Myrciaria alta* (Myrtaceae), a new species from Espírito Santo, Brazil. *Phytotaxa* 414(4): 187–193. <https://doi.org/10.11646/phytotaxa.414.4.5>
- Fraga C.N., Formigoni M.H. & Chaves F.G. 2019. Fauna e flora ameaçadas de extinção no estado do Espírito Santo. Instituto Nacional da Mata Atlântica, Santa Teresa.
- Goldenberg R. & Kollmann L.J. 2016. Two new species of *Pleroma* (Melastomataceae) from Espírito Santo, Brazil. *Brittonia* 68: 37–45. <https://doi.org/10.1007/s12228-015-9390-4>
- Gonçalves A.S. 2019. Augusto Ruschi: notas biográficas. Comunicação Impressa, Santa Teresa.
- Harris J.G. & Harris M.W. 2001. Plant identification terminology: an illustrated glossary. Second edition. Spring Lake Publishing, Spring Lake.
- IBGE – Instituto Brasileiro de Geografia e Estatística 2006. Censo agropecuário 2006. Available from <https://cidades.ibge.gov.br/> [accessed 2 Feb. 2020].
- IBGE – Instituto Brasileiro de Geografia e Estatística 2017. Censo agropecuário 2017. Available from <https://cidades.ibge.gov.br/> [accessed 2 Feb. 2020].
- IUCN 2012. IUCN Red List Categories and Criteria. Version 3.1. Second edition. IUCN, Gland, Switzerland & Cambridge, UK.

- Available from <https://portals.iucn.org/library/node/10315> [accessed 27 Feb. 2020].
- IUCN 2019. Guidelines for using the IUCN red list categories and criteria. Version 14. Prepared by the Standards and Petitions Subcommittee. Available from [https://nc.iucnredlist.org/redlist/content/attachment\\_files/RedListGuidelines.pdf](https://nc.iucnredlist.org/redlist/content/attachment_files/RedListGuidelines.pdf) [accessed 27 Feb. 2020].
- Kraaij T., Baard J.A. & Crain B.J. 2016. Conservation status and management insights from tracking a cryptic and Critically Endangered species of Orchidaceae. *Oryx* 51(3): 441–450. <https://doi.org/10.1017/S0030605316000272>
- LAPIG – Laboratório de Processamento de Imagens e Geoprocessamento 2020. Santa Teresa - Espírito Santo. Available from <https://www.lapig.iesa.ufg.br/lapig/> [accessed 28 Mar. 2020].
- Lírio E.J. & Peixoto A.L. 2015. A new species of *Mollinedia* (Monimiaceae, Mollinedioideae, Mollinedieae) from Atlantic rainforest, Brazil. *Phytotaxa* 239(1): 89–95. <https://doi.org/10.11646/phytotaxa.239.1.9>
- Lírio E.J. & Peixoto A.L. 2017. Flora do Espírito Santo: Monimiaceae. *Rodriguésia* 68(5): 1725–1765. <https://doi.org/10.1590/2175-7860201768513>
- Lírio E.J., Peixoto A.L. & Siqueira M.F. 2015. Taxonomy, conservation, geographic and potential distribution of *Macrotorus* Perkins (Mollinedioideae, Monimiaceae), and a key to the Neotropical genera of Monimiaceae. *Phytotaxa* 234(3): 201–214. <https://doi.org/10.11646/phytotaxa.234.3.1>
- Lírio E.J., Freitas J., Negrão R., Martinelli G. & Peixoto A.L. 2018. A hundred years' tale: rediscovery of *Mollinedia stenophylla* (Monimiaceae) in the Atlantic rainforest, Brazil. *Oryx* 52(3): 437–441. <https://doi.org/10.1017/S0030605316001654>
- Lírio E.J., Pignal M. & Peixoto A.L. 2020. Monimiaceae. In: Flora do Brasil 2020. Jardim Botânico do Rio de Janeiro. Available from <http://floradobrasil.jbrj.gov.br/> [accessed 26 Feb. 2020].
- Lorence D.H. 1999. Two new species of *Mollinedia* (Monimiaceae) from southern Mexico. *Candollea* 54: 433–438.
- Lorence D.H. 2011. Monimiaceae. In: Davidse G., Sánchez-Sousa M., Knapp S. & Cabrera F.C. (eds) Flora Mesoamericana vol. 2(1): 1–15. Universidad Nacional Autónoma de México, México.
- Martins E.M., Fernandes F., Maurenza D., Pougy N., Loyola R. & Martinelli G. 2014. Plano de ação nacional para a conservação do faveiro-de-wilson (*Dimorphandra wilsonii* Rizzini). Andrea Jakobsson Estúdio & Instituto de Pesquisa Jardim Botânico do Rio de Janeiro, Rio de Janeiro.
- Molz M. & Silveira D. in press. A new endemic species of *Mollinedia* (Mollinedieae, Monimiaceae) from the southern limit of the Atlantic coastal moist forest. *Phytotaxa*.
- Moraes P.L.R. & Vergne M.C. 2017. *Ocotea batata* (Lauraceae), a new species from Brazil. *Harvard Papers in Botany* 22(1): 61–70. <https://doi.org/10.3100/hpib.v22iss1.2017.n7>
- Oliveira P.N., Gil A.S.B., Giulietti A.M., Oliveira R.P. & Amaral M.C.E. 2016. *Neomarica castaneomaculata* and *N. involuta* (Iridaceae): two new endemic species from the Atlantic forest, Brazil. *Phytotaxa* 286(2): 89–98. <https://doi.org/10.11646/phytotaxa.286.2.3>
- Payne W.W. 1978. A glossary of plant hair terminology. *Brittonia* 30(2): 239–255. <https://doi.org/10.2307/2806659>
- Peixoto A.L. 1979. Contribuição ao conhecimento da seção Exappendiculate Perkins do gênero *Mollinedia* Ruiz et Pavon (Mollinedieae, Monimioideae, Monimiaceae). *Rodriguésia* 50: 135–222.
- Peixoto A.L. 1983. Uma nova espécie para o gênero *Mollinedia* Ruiz et Pavon (Monimiaceae, Monimioideae). *Revista Brasileira de Botânica* 6: 19–21.
- Peixoto A.L. & Pereira-Moura M.V.L. 2008. A new genus of Monimiaceae from the Atlantic coastal forest in South-Eastern Brazil. *Kew Bulletin* 63: 138–141. <https://doi.org/10.1007/s12225-007-9004-8>
- Perkins J. 1898. Beitrage zur Kenntniss der Monimiaceae. I. Über die Gliederung der Gattungen der Mollinedieae. *Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie* 25: 547–577.
- Perkins J. 1900. Monographie der Gattung *Mollinedia*. *Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie* 27: 636–683.
- Philipson W.R. 1987. A classification of the Monimiaceae. *Nordic Journal of Botany* 7(1): 25–29. <https://doi.org/10.1111/j.1756-1051.1987.tb00911.x>
- Philipson W.R. 1993. Monimiaceae. In: Kubitzki K., Rohwer J.G. & Bittrich V. (eds) The families and genera of vascular plants. Vol. 2. Flowering plants. Dicotyledons: magnoliid, hamamelid and caryophyllid families: 426–437. Springer Verlag, Berlin.
- Renner S.S., Strijk J.S., Strasberg D. & Thébaud C. 2010. Biogeography of the Monimiaceae (Laurales): A role for East Gondwana and long distance dispersal, but not West Gondwana. *Journal of Biogeography* 37(7): 1227–1238. <https://doi.org/10.1111/j.1365-2699.2010.02319.x>
- Ruiz L.H. & Pavón J.A. 1794. *Florae Peruvianaee et Chilensis, Prodromus*. First edition. 83.t.15. Madrid.
- Saiter F.Z., Guilherme F.A.G., Thomaz L.D. & Wendt T. 2011. Tree changes in a mature rainforest with high diversity and endemism on the Brazilian coast. *Biodiversity and Conservation* 20(9): 1921–1949. <https://doi.org/10.1007/s10531-011-0067-3>
- Saiter F.Z. & Thomaz L.D. 2014. Revisão da lista de espécies arbóreas do inventário de Thomaz & Monteiro (1997) na Estação Biológica de Santa Lúcia: o mais importante estudo fitossociológico em florestas montanas do Espírito Santo. *Boletim do Museu de Biologia Mello Leitão Nova Série* 34: 101–128. [http://boletim.sambio.org.br/pdf/34\\_06.pdf](http://boletim.sambio.org.br/pdf/34_06.pdf)
- Thomaz L.D. & Monteiro R. 1997. Composição florística da Mata Atlântica de encosta da estação Biológica de Santa Lúcia, município de Santa Teresa-ES. *Boletim do Museu de Biologia Mello Leitão Nova Série* 7: 3–48. Available from [http://boletim.sambio.org.br/pdf/07\\_01.pdf](http://boletim.sambio.org.br/pdf/07_01.pdf) [accessed 16 Nov. 2020].
- Sobral M., Costa I.G., Souza M.C. & Zorzanelli P.F. 2017. Five new species and one new combination in Brazilian Myrtaceae. *Phytotaxa* 307(4): 233–244. <https://doi.org/10.11646/phytotaxa.307.4.1>
- Thiers B. continuously updated. Index Herbariorum: a global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. Available from <http://sweetgum.nybg.org/ih/> [accessed 6 Mar. 2020].
- Trad R.J., Bittrich V. & Amaral M.C.E. 2018. *Kielmeyera fatimae* (Calophyllaceae): a new species from Santa Teresa, Espírito Santo, Brazil. *Novon: A Journal for Botanical Nomenclature* 26(2): 168–173. <https://doi.org/10.3417/2018039>
- Turland N.J., Wiersema J.H., Barrie F.R., et al. (eds) 2018. International Code of for algae, fungi, and plants (Shenzhen Code) adopted by the Nineteenth International Botanical Congress Shenzhen, China, July 2017. *Regnum Vegetabile* 159. Koeltz Botanical Books, Glashütten. <https://doi.org/10.12705/Code.2018>

Zhang Q., Luo X. & Chen Z. 2014. Conservation and reintroduction of *Firmiana danxiaensis*, a rare tree species endemic to Southern China. *Oryx* 48(4): 485.  
<https://doi.org/10.1017/S0030605314000581>

Communicating editor: Brecht Verstraete.

Submission date: 6 Apr. 2020

Acceptance date: 10 Sep. 2020

Publication date: 23 Mar. 2021