

# A hundred years' tale: rediscovery of *Mollinedia stenophylla* (Monimiaceae) in the Atlantic rainforest, Brazil

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**Abstract** The plant *Mollinedia stenophylla* Perkins (Monimiaceae) is endemic to southern Brazil and, until 2015, had not been seen for 122 years. We located a single population of the species on the margin of a watercourse in the mountainous region of Rio de Janeiro state. We describe the location of the species, comment on its morphology, ecology and conservation, assess its conservation status, propose conservation measures, and discuss the potential value of local action plans for this and other narrow endemic plant species. *Mollinedia stenophylla* has whorled leaves, clonal reproduction and a low height, unusual traits in the genus *Mollinedia*. Using the IUCN Red List criteria we assess the species as Critically Endangered. This example highlights the importance of investing time in plant surveys and taxonomy, especially in megadiverse countries such as Brazil.

**Keywords** Brazil, clonal reproduction, habitat specificity, Monimiaceae, narrow endemic, point endemic, Red List, threatened species

Monimiaceae is a pantropical family of flowering plants comprising 28 genera and c. 200 species (Renner et al., 2010) occurring mainly in moist and well conserved forests, with many species being rare and endemic to restricted areas (Philipson, 1993; Peixoto & Pereira-Moura, 2008) and thus susceptible to threats such as deforestation and fires (Peixoto et al., 2013). The family is highly diversified in Neotropical rain forests, including in Brazil, and particularly in the state of Rio de Janeiro, where five genera and 33 species occur, mostly on mountains (BFG, 2015).

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The Protected Area of Macaé de Cima, in the Nova Friburgo municipality, holds the highest number of Monimiaceae species in the state (16 species) and in Brazil (Peixoto & Pereira-Moura, 1996; IUCN, 2016b). Seven are endemic to the area and some are known only from 19th century collections. This area is important for conservation because of the presence of species with restricted distributions (Diniz et al., 2017).

*Mollinedia stenophylla* was described by Perkins (1900) based on specimens collected by Glaziou in 1888 (Glaziou, n. 17768) and 1893 (n. 20220), both from Macaé de Cima. Another specimen was collected in 1832 (Riedell & Luschnath, n. 315), from the same locality, but not cited by Perkins in the protologue. Since the collection of these specimens no living population had been encountered, despite extensive fieldwork in the area during 1989–1993 (Lima & Guedes-Bruni, 1997). However, in 2015 we rediscovered a population of *M. stenophylla* in Macaé de Cima (Fig. 1) in the same area where it had last been collected 122 years previously.

There is a general concern in plant conservation regarding the best strategies to conserve narrow endemic species such as *M. stenophylla*. Potential strategies include research on artificial propagation, ecophysiology and pollination, monitoring, threat mitigation, reintroduction and ex situ conservation (Martins et al., 2014; Zhang et al., 2014; Kraaij et al., 2016). Here we describe the geographical distribution of *M. stenophylla*, comment on its morphology, ecology and conservation, and make a new Red List assessment.

Branches of eight plants with flowers and fruits were collected (Lírio vouchers 1219, 1220, 1224, 1253, 1255, 1256, 1257, 1258) and deposited at RB, M, MBML, NY and P herbaria (acronyms follow Thiers, 2016). Extent of Occurrence (EOO) was calculated using the area of the minimum convex polygon, and Area of Occupancy (AOO) using a grid of 4 km<sup>2</sup> cells (IUCN, 2016a).

The living population of *M. stenophylla* was found in the surroundings of a waterfall in Macaé de Cima. The species is dioecious (Plate 1), easily recognized by its whorled leaves and low height (< 1 m), which are unique characteristics in the genus *Mollinedia*. The species has small (c. 0.8 × 0.6 cm), blackish-purple drupelets (fruits) with contrasting, yellowish receptacles (Plate 1c).

We observed that *M. stenophylla* exhibits clonal reproduction, with aerial stems that fall on moist soil and produce

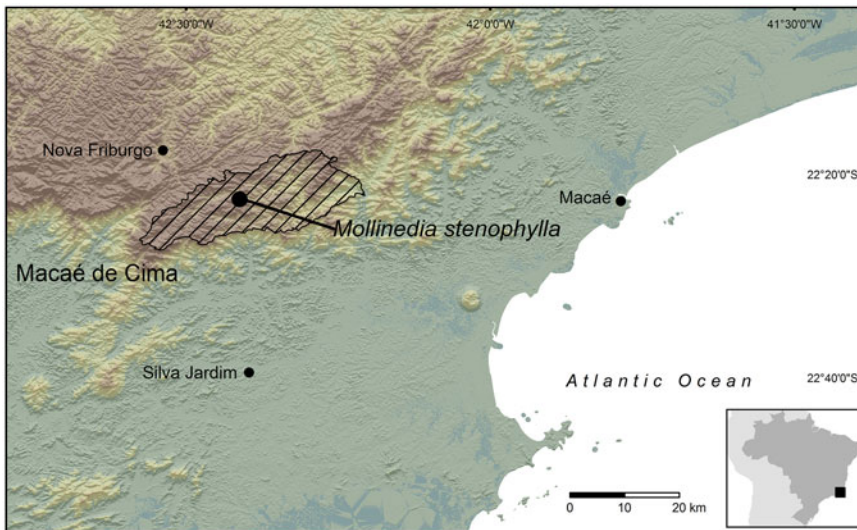


FIG. 1 The single known location of *Mollinedia stenophylla* in Rio de Janeiro state, Brazil.

roots, resulting in new individuals (Plate 1f), a phenomenon not previously reported for Neotropical Monimiaceae. Mature specimens were observed with stems  $< 1$  m tall and 1.5 cm diameter, an uncommon characteristic in Neotropical Monimiaceae, suggesting a neotenic stage. The rediscovered population had 49 mature individuals, 13 of them pistillate, and c. 30 seedlings, with an AOO of 4 km<sup>2</sup>.

The restricted distribution of this species is probably a result of its dependency on water. Its small, coloured drupelets are attractive to birds that are potential dispersers for *Mollinedia* (Lirio et al., 2015), as for other species of *Mollinedia* (Lorence, 1985; Renner & Hausner, 1997).

*Mollinedia stenophylla* was previously categorized as Endangered by Peixoto (1992) and included in the 2008 Official Threatened Flora Species List of Brazil (MMA, 2008), and it is currently categorized as Endangered on the IUCN Red List, although this needs updating (Varty, 1998). CNCFlora (2012) assessed the species as Near Threatened based on its EOO, including presumed occurrences in Espírito Santo state, and therefore it wasn't included in the 2014 Official Threatened Flora Species List of Brazil (MMA, 2014). However, ongoing revision of Neotropical Monimiaceae by EJJ and ALP indicates the species is known only from Macaé de Cima. Specimens from Espírito Santo state, previously determined as *M. stenophylla*, appear to be an undescribed species.

The single known population of *M. stenophylla* has few individuals, and a restricted distribution at a single location that is on the access trail to a waterfall, and hence tourism and housing are the main threats (Mendes, 2010). Macaé de Cima is categorized as a low protection conservation unit in which visitation and human settlement are permitted. It is therefore likely that AOO, EOO and habitat quality will decline, and *M. stenophylla* should be recategorized as Critically Endangered based on criteria (IUCN, 2012) B2ab (ii, iii) + C2ai + D.

*Mollinedia stenophylla* could be considered rare (sensu Rabinowitz et al., 1986; Caiafa & Martins, 2010) because of its narrow geographical range, habitat specificity and low population size. Rare species are more susceptible to extinction than more common species, and may incorrectly be presumed extinct if they have not been observed for many years (Collar, 1998; Penedo et al., 2015).

In a megadiverse country such as Brazil assessment of the extinction risk of species is likely to be slow as there are a large number of species to assess (only c. 17% of the native flora of Brazil has so far been assessed), and improving knowledge of taxonomy and distributions affects previous conservation assessments (Moraes et al., 2014; CNCFlora, 2017, in press). This highlights the importance of investing time in visiting herbaria, and in fieldwork and taxonomy, to update Red Lists.

We recommend the development of an action plan for *M. stenophylla*, including in situ conservation to control local threats and an ex situ approach to improve cultivation methods, practical management of risks and a strategy to maintain genetic diversity (Cavender et al., 2015). Such strategies have been proposed to protect narrow endemic species (Fenu et al., 2011; Martinell et al., 2011; Cogoni et al., 2013; Li et al., 2014; Martins et al., 2014).

Currently, there are six individuals of *M. stenophylla* in the living collection of Rio de Janeiro Botanical Garden, which have been cultivated in the greenhouse since January 2015. However, seeds need to be collected for storage and the maintenance of genetic diversity, and studies are needed, in natural populations and living collections, of phenology, pollination, dispersal, the dioecious sexual system and vegetative reproduction.

Faced with the challenge of preparing action plans for all threatened plants, the National Centre for Flora Conservation has implemented local action plans (e.g. Pougy et al., 2015a,b) for threatened, data deficient and

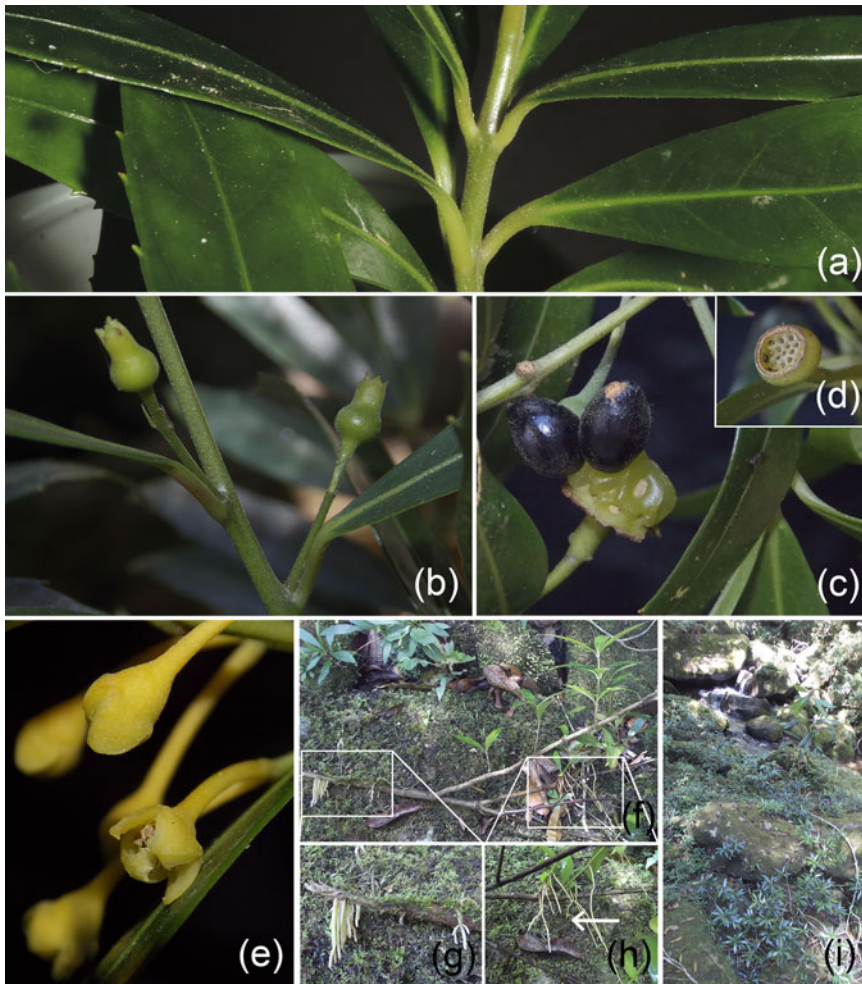


PLATE 1 The (a) branch and whorled leaves, (b) pistillate flowers, (c) fruit receptacle and drupelets, (d) empty receptacle, (e) staminate flowers, (f) clonal reproduction (details in g,h), and (i) habitat of *M. stenophylla*.

near threatened species that occur in the same area. There are 41 other endemic plant species with a restricted distribution in Macaé de Cima (CNCFlora, 2017, in press). An action plan with a territorial approach provides a list of indicators that facilitate recognition of the studies and actions required for threat mitigation.

The extinction risk assessment of the endemic species of Rio de Janeiro state was carried out by CNCFlora, the National Red List Authority, in partnership with the State Secretariat for the Environment of Rio de Janeiro (SEA-RJ) and with the collaboration of more than 100 taxonomists. The Red Book of Rio de Janeiro Endemic Flora is complete and will be published in 2017. The migration of these data to the IUCN system and the territorial action plan for the endemic species of the state of Rio de Janeiro is ongoing.

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### Author contributions

EJJ collected the species, EJJ and ALP identified the species, RN and GM made the risk assessment, JF prepared the Plate, and EJJ, JF, RN, GM and ALP wrote the article.

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