

New records and geographic distribution of *Glaziophyton mirabile* (Poaceae: Bambusoideae)

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ABSTRACT: *Glaziophyton* Franch. is a monotypic bamboo genus (*G. mirabile* Franch.), narrowly endemic to the Campos de Altitude in the state of Rio de Janeiro, southeast Brazil. Five occurrence sites are known, but one is considered locally extinct and, at two sites, the species has not been recollected for several years. Due to its restricted geographical range *G. mirabile* is classified as a threatened species. In this study we report two new populations. These new records might change the species conservation status and the category of its extinction risk.

Poaceae Barnhart is a cosmopolitan plant family with more than 700 genera and 10,000 species (Clayton *et al.* 2006; Souza and Lorenzi 2008; The Plant List 2010). Brazil presents an incredible diversity of grasses, including bamboos, counting approximately 210 genera and 1,414 species (Burman and Filgueiras 1993; Filgueiras *et al.* 2012). The monotypic genus *Glaziophyton* Franch. has intrigued naturalists and scientists since the beginning of the nineteenth century, as exemplified by McClure's (1973) exclamation after his description of the species: "How long will the "satiated curiosity" of technically equipped persons ignore the challenge to investigate this enigma in depth?!"

G. mirabile Franch. was first collected in 1877 by French landscape architect and field botanist Auguste F.M. Glaziou, who worked for more than 15 years gathering material to support the species description. In 1893, Franchet, Glaziou's compatriot, provided its proper botanic classification (Burman and Soderstrom 1990; Judziewicz 2000). This rare species (Giulietti *et al.* 2009) is considered a narrow endemic and is restricted to Rio de Janeiro state, occurring on the highest granitic mountain tops of the central portion of the Serra do Mar, also called

Serra dos Órgãos (Judziewicz *et al.* 1999; Shirasuna 2012). This windswept páramo-like vegetation is known in Brazil as *Campos de Altitude* (Martinelli 1996; 2007).

According to McClure (1973), Glaziou compared *G. mirabile* to a monstrous species of rush (*Juncus*), specifically, a 2-meter-tall version of the common *J. effusus* L., which was recorded for the same geographical region and elevation range in Brazil. Franchet, however, compared *Glaziophyton* to other Cyperaceae species, such as *Scirpus lacustris* L. and *Cyperus articulatus* L. (Franchet 1889). The culms of *G. mirabile* are typically leafless, almost herbaceous, and aggregated in dense clumps. The peculiar juncoid nature of the culm internodes' septate lumina in *Glaziophyton* apparently has not been described for any other known bamboo species. The chambered culms of *G. mirabile* are hollow with pithy partitions at short intervals (McClure 1973; Burman and Soderstrom 1990; Judziewicz *et al.* 1999). For these reasons, two specialists considered it the oddest bamboo in the world (Burman and Soderstrom 1990).

The uniqueness of this species, and its exaggerated ontogenetic features, are expressed morphologically (McClure, 1973) and phylogenetically. Tyrrell *et al.* (in press/ accepted) present a molecular study conducted on the Arthrostylidiinae subtribe that suggest that *Glaziophyton* is part of a small clade, sister to the rest of Arthrostylidiinae, which includes at least one Brazilian species of *Aulonemia*. Given these reasons, according to L.G.Clark (personal communication), the conservation of *G. mirabile* is critical to understanding a major group of Neotropical woody bamboos' evolution.

Since Glaziou collected the type collection at Pico do Tinguá and a few other samples around the municipality of Petrópolis, the species had not been collected for more than 80 years. It was only in 1979 that botanist Gustavo Martinelli recollected it. He found four clumps of the species at the top of the Morro do Cuca, a different site on the same mountain range. Later, different botanists, such as Lynn G. Clark and Cyl C. Farney collected the species at the same locality. More recently, the present authors



FIGURE 1. Fertile individual of *Glaziophyton mirabile* at Serra da Maria Comprida, Petrópolis, Rio de Janeiro, Brazil.

conducted extensive surveys (eight years of periodical visits) of the Morro do Cuca population, but were not able to find species clumps, which lead us to consider it as locally extinct. Occurrences were also recorded at three other sites (Pedra do Açú, Pedra do Inferno and Pico do Tinguá) above 1.400 m.s.m (Table 1). Normally, the populations are described as scattered; however, Haroldo C. Lima, in 2002, described the Pico do Tinguá population as locally abundant.

Herein, we report two new populations in the municipality of Petrópolis and present an undated species geographic distribution map (Figure 2) along with a satellite image (Landsat 7 ETM - RGB composition) of the region showing the occurrence records (Figure 3). Expeditions to the higher altitudes of the Serra da Maria Comprida undertaken under the auspices of the National Centre for Flora Conservation (CNCFlora), revealed two previously unknown populations based on specimens collected by the present authors, in July 2008. The sites are locally known as Boi Coroado and Porto das Antas,

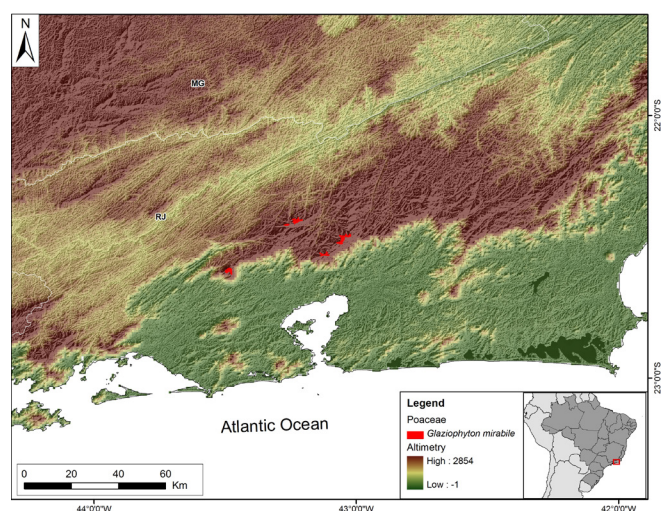


FIGURE 2. Geographical distribution map of *Glaziophyton mirabile*.

TABLE 1. *Glaziophyton mirabile* occurrence sites.

SITE	MUNICIPALITY	GEOREFERENCE	VOUCHERS	LAST COLLECTION
Morro da Bandeira	Petrópolis	22°29'20" S 43°04'47" W	A.F.M Glaziou 14383 Syntype (P)	> 120 years
Morro do Cuca	Petrópolis	22°25'05" S 43°15'54" W	G. Martinelli 6168, 6169, 6170, 6171, 6172, 9027, 9333 (RB-JBRJ); L. G. Clark 785 (HSJRP) *	20 years
Boi Coroado	Petrópolis	22°24'27" S 43°14'21" W	M.A. Moraes 153 (RB-JBRJ) **	3 years
Porto das Antas	Petrópolis	22°24'17" S 43°13'32" W	M.A. Moraes 153 (RB-JBRJ) **	3 years
Morro do Inferno	Petrópolis	22°32'05" S 43°07'36" W	R. Ribeiro 712 (RB-JBRJ); C. Farney 1110 (RB-JBRJ)	26 years
Pedra do Açú	Petrópolis	22°29'11" S 43°03'47" W	A.F.M. Glaziou 17914 Syntype (P)+; P. von Luetzelburg 6524 (RB-JBRJ)	95 years
Pico do Tinguá	Nova Iguaçu	22°35'24" S 43°29'04" W	A.F.M Glaziou 8999 Type (P); H.C. de Lima 6000 (RB-JBRJ)	9 years

* This collection has more duplicates deposited in other Brazilian herbaria. But they could not be accessed because the collections are not digitally available.

** Boi Coroado and Porto das Antas are two different contiguous sites; the first is an elevation and the second a valley. A continuous population of *G. mirabile* was recorded occupying both sites. Due to the species rarity and the absence of flowering individuals in the field, only one collection at Boi Coroado was made and is being used to testify occurrence in both sites.

+ A.F.M. Glaziou collection number 17914 has been described for Serra dos Órgãos. Although Pedra do Açú was not mentioned as the actual locality, we assume that this mountain is the precise occurrence site, because it is the only place in this mountain range where the species was ever collected.

and are located within the permanent protection area ("Zona de Vida Silvestre") of a federal conservation unit - Environment Protection Area of Petrópolis ("Área de Proteção Ambiental da Região Serrana de Petrópolis - A.P.A. Petrópolis"). Although population estimates have not been made, the species seems to be locally abundant at these sites, without direct threats.

In situ observations have shown that *G. mirabile* occurs in dense clumps associated with species of *Chusquea*, forming a continuous and dominant bamboo grassland that grows on the mountain slopes and tops (Figure 4). Although *Chusquea* is considered to be an Andean-centered genus (Clark 1995), southeastern Brazil represents a major center of diversity for *Chusquea*, with 36 described species and at least a dozen that remain to be described (Moreira et al. 2008). Underneath this dominant

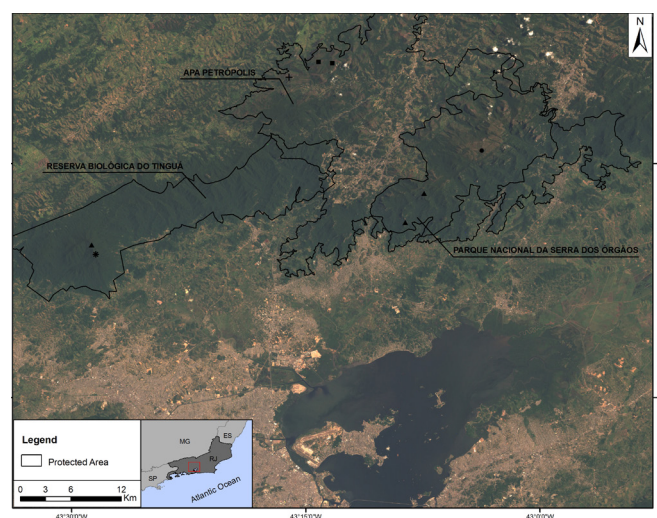


FIGURE 3. Landsat 7 ETM satellite image (RGB composition) of Serra do Mar mountain range evidencing the conservation units of the region and *Glaziophyton mirabile* occurrence sites. APA Petrópolis is a protected area of sustainable use while Reserva Biológica do Tinguá e Parque Nacional da Serra dos Órgãos are fully protected reserves. * = type collection; ▲ = occurrence records; ■ = new records; ● = uncertain occurrence; † = locally extinct.



FIGURE 4. Sterile *Glaziophyton mirabile* clump at Boi Coroado summit.

bamboo grassland, another peaty mat is formed by mosses acting as a substrate for establishing an incredible array of species, such as the insectivores *Utricularia nephrophylla* Benj. and *Drosera villosa* St. Hil. Several threatened species also occur in these sites, including the Brazilian Empress *Worsleya procera* (Lem.) Traub. an endemic giant-lily popularly known as “Imperatriz do Brasil” (Brazilian Empress) and *Pitcairnia glaziovii* Baker, a bromeliad restricted to the high pristine inselbergs of Rio de Janeiro and Espírito Santo states (Leme et al. 2009; Forzza et al. 2012).

The two recently discovered *G. mirabile* populations represent a significant increase (261,8 km²) in the species' Extent of Occurrence (EOO). Disregarding the locally extinct Morro do Cuca population, the EOO increased from 72,7 km² to 334,5 km². Given that the extinction risk assessment of *G. mirabile* was based on the geographical range as EOO, the recent discoveries would imply a genuine extinction risk category change (as proposed by IUCN Standards and Petitions Working Group 2011). The species would be down-listed from *Critically Endangered* (CR) to *Endangered* (E), according to the International Union for Conservation of Nature framework (IUCN, 2001) criteria. Nevertheless, we believe that population surveys need to be undertaken to support a better extinction risk assessment.

Despite *G. mirabile*'s phylogenetic significance (Tyrrell et al. in press/ accepted) and a clear reduction of the species' area of occupancy, no specific conservation actions have been undertaken so far. Previous experiments on growing the species outside its natural habitat have been conducted by T.R. Soderstrom and G. Martinelli at the Rio de Janeiro Botanical Garden (JBRJ), but they were unsuccessful. Therefore, applied research is needed to establish a viable *ex situ* collection.

The species populations are located in rocky outcrops surrounded by the Atlantic Forest. But the incidence of different anthropogenic factors, such as fire and buffer zone reduction, may threaten its persistence in nature. For this reason we recommend mitigating actions which would promote better protection for *G. mirabile* and other Campos de Altitude plant species, including federal and state surveillance at the conservation units, adequate fencing and demarcation of limits, and local implementation of environmental educational programs.

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