



Taxonomy and conservation status of *Tripogandra warmingiana* (Seub.) Handlos (Commelinaceae), a previously obscure taxon from Brazil

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Abstract

Tripogandra warmingiana is one of many poorly known and infrequently collected taxa of Commelinaceae in Brazil, and previously was known exclusively from the type collection and few historical collections from Minas Gerais. It is reported here for the first time for the states of Bahia and Rio de Janeiro, where it occurs exclusively in the Atlantic Rainforest, between 50–800 elev. A new description is provided to better characterize the species. A newly revised key for the Brazilian species of the genus is presented that includes the new data presented here for *T. warmingiana* and some overlooked species. Commentaries on IUCN conservation status are also presented.

Resumo

Tripogandra warmingiana, um dos inúmeros táxons de Commelinaceae, conhecidos exclusivamente para sua localidade tipo e por algumas coletas históricas (todas provenientes do estado de Minas Gerais). A mesma é aqui relatada pela primeira vez para os estados da Bahia e Rio de Janeiro, ocorrendo em Floresta Atlântica, entre 50–800 m.s.m., de maneira pontual. É apresentada uma nova descrição para a espécie, juntamente com uma chave revisada para os táxons brasileiros do gênero. Essa chave inclui também algumas espécies previamente consideradas duvidosas ou não registradas para o Brasil. Além disso, aqui será designado pela primeira vez, um status de conservação para *T. warmingiana*, baseado nos critérios da IUCN.

Key words: Atlantic Rainforest, Cerrado, endemism, IUNC Red List

Introduction

The Commelinaceae can be distinguished from the other monocotyledons by their succulent stems, closed leaf sheaths, cincinnus inflorescences and deliquescent flowers (Faden 1991). The family comprises 42 genera and ca. 670 species (Faden & Hunt 1991; APG III 2009; Hardy & Faden 2004; Aona *et al.* 2012; Aona-Pinheiro & Amaral 2012), having mainly a tropical and subtropical distribution and four centers of diversity: northeastern Brazil [*Dichorisandra* J.C.Mikan (1820: 1)], Africa [*Aneilema* R.Brown (1980: 270)], Mexico [*Gibasis* Rafinesque (1837: 16)] and Asia [*Commelina* Linnaeus (1753: 40)] (Aona 2008; Faden 1991; Hunt 1986; Gajurel & Shrestha 2009, respectively). Due to the lack of electronic access to specimens and literature, little administrative commitment to long term projects and low funding for alpha taxonomy, and due especially to

the decreasing number of taxonomists, many geographical areas lack recent floras and many plant genera have outdated taxonomic information (Funk 2006). Commelinaceae is no exception, with few specialists in Brazil (Barreto 1997). In addition, study of the family is complicated by the fact that it is one of the most awkward families to study using dried specimens, because the deliquescent flowers are normally poorly, if at all, preserved. The difficulty in making use of such material is no doubt a contributing factor to the paucity of modern monographic studies in the family (Faden 1991).

Of the 14 genera of Commelinaceae that occur in Brazil (Aona & Pellegrini 2012), only *Tripogandra* Rafinesque (1837: 16), *Gibasis*, *Plowmanianthus* Faden & C.R. Hardy (2004: 316) and *Dichorisandra* have received taxonomic revision (Handlos 1975; Hunt 1986; Hardy & Faden 2004; Aona 2008). The remaining genera continue to be taxonomically obscure. Partially because of this, few if any collecting efforts have been made to recollect many of the species, including those known exclusively from the type collection or from historic collections (Barreto 1997).

The Neotropical genus *Tripogandra* currently comprises 36 species (The Plant List 2010), with 7 species listed for Brazil (Aona & Pellegrini 2012). It is part of subfamily Commelinoideae, tribe Tradescantieae, subtribe Tradescantiinae (Faden & Hunt 1991; Evans *et al.* 2003) and can be distinguished from other genera of the subtribe by its double cincinni inflorescences, which are not subtended by foliaceous bracts as in *Tradescantia* Linnaeus (1753: 288), by its two whorls of dimorphic stamens (three opposite to the sepals and pointing downward and three opposite to the petals pointing upwards) and spinose pollen grains (Faden & Hunt 1991). Handlos (1975) revised the genus using mostly herbaria material and limited living material, essentially from Mexican species. As indicated, no collection effort was made throughout the main area of occurrence of the genus. This left gaps in the description of the extra-Mexican species, as well as an undescribed micro-endemic species (*e.g.* *Tripogandra elata* D.R. Hunt [1979: 405]) from central Brazil.

Tradescantia warmingiana was described by Seubert (1872: 126) based solely on herbaria material, which led to many gaps and errors in the original description. Handlos (1975) transferred *Tradescantia warmingiana* to *Tripogandra*, and made the possible corrections on Seubert's description. Handlos considered it a distinct species and not part of Clarke's *Tripogandra elongata* (G. Meyer 1818: 146) Woodson (1942: 152) [= *T. diuretica* (Martius 1823: 281) Handlos (1975: 259)], emphasizing the size of the plant, the shape of the leaf blade, flower size, stigma and seeds as important characters to separate them. Additionally, it was considered an extremely rare species and little was known about it. When the revision was published only 3 collections in the type locality were known. Since Seubert and Handlos had no access to fresh material or spirit collections of *T. warmingiana*, many problems associated with the original description have persisted. Until now, it was believed that no other collection of this species was extant due probably to the extensive deforestation of the Cerrado vegetation (Klink & Machado 2005), one of the two Brazilian hotspots for conservation (Myers *et al.* 2000). Despite that, no proper IUCN conservation status was given.

The present work aims to report the recent rediscovery of *Tripogandra warmingiana* (Seub.) Handlos (1975: 311) and discuss its expanded area of occurrence, which was known exclusively from the type collection and a few historical collections. A complete and updated taxonomic treatment is provided based on herbarium collections, cultivated material and field studies. Additionally, we present a revised key of the genus for Brazil and some conservational aspects.

Methods

Field trips and herbarium study were conducted during the preparation of the Rio de Janeiro state Flora, and aimed for the poorly collected areas and areas with dubious or new occurrences. Specimens of *Tripogandra* were collected and maintained in cultivation to observe, photograph and analyze fresh flowers, fruits and seeds, and to observe other phenological data. The distribution of the Brazilian *Tripogandra* given here is based on Handlos (1975), Aona & Pellegrini (2012) and herbaria material. The classification of the vegetation patterns follows Veloso *et al.* (1991). The fertile material was deposited at RB. Additional specimens from the

following herbaria were analyzed: C (photo), CEPEC (photo), GUA, HB, HUEFS (photo), K (photo), MBM, NY, P (photo), R, RB, RFA e US (photo) [herbarium acronyms according to Thiers 2012].

Results

A revised key to the Brazilian species of the genus is presented here. It includes *T. elata*, which was published after the genus' revision (Handlos 1975) and the new data on the description of *T. warmingiana*. The key also includes *T. neglecta* Handlos (1975: 287), which was considered a synonym of *T. diuretica* (Barreto 1997), and *T. serrulata* (Vahl 1798: 4) Handlos (1970: 33) which was only recently reported for Brazil (Aona & Pellegrini 2012). Detailed comments and precise localities are given below.

Key to the Brazilian species of *Tripogandra*

1. Leaves folded (rarely flat); stamens opposite to the sepals bearded, stamens opposite to the petals glabrous, concave in the upper third *Tripogandra glandulosa* (Fig. 4d–e)
[Southern Bolivia and Brazil, Paraguay, Uruguay and Northeastern Argentina- in swampy places and along streams]
- Leaves flat; stamens opposite to the sepals glabrous, stamens opposite to the petals bearded, terete or inflated in the upper third 2
2. Plants erect or caespitose; leaf base symmetric (sheathing, cuneate or obtuse), if slightly asymmetric midvein oblique..... 3
- Plants prostrate; leaf base always asymmetric (one side sheathing and the other sub-cordate), midvein always oblique..... 5
3. Leaves sub-petiolate, of uniform size, midvein oblique; inflorescences terminal; stamens opposite to the petals with filaments inflated in the upper third; seeds costate, hilum elliptic..... *Tripogandra brasiliensis* (Fig. 4a)
[Maranhão and Minas Gerais states- in the Caatinga and the Cerrado vegetation]
- Leaves sessile, of varying size but always longer below and shorter towards apex, midvein not oblique; inflorescences axillary and terminal; stamens opposite to the petals with filaments terete in the upper third; seeds reticulate, hilum punctiform 4
4. Leaf base cuneate; sepals sparsely pilose in the junction with adjacent sepals; stamens opposite to the petals with elongated anthers sacs, connective not expanded; capsules globose *Tripogandra neglecta* (Fig. 4f)
[Minas Gerais state- probably at Floresta de Galeria in the Cerrado vegetation]
- Leaf base sheathing; sepals glabrous; stamens opposite to the petals with elliptic anthers sacs, connective expanded and oblong; capsules ovoid to ellipsoid *Tripogandra elata* (Fig. 4c)
[Goiás and Distrito Federal- in the Cerrado vegetation]
5. Plants prostrate, apex of the stems also prostrate; leaves not congested at the apex of the stems, basal leaves sub-petiolate, apical leaves sessile, membranous; 1–8 flowers per inflorescence; peduncles up to 1.5 cm long; anthesis occurring in the afternoon. *Tripogandra warmingiana* (Fig. 1–2)
[Bahia, Minas Gerais and Rio de Janeiro states- in the Atlantic Rainforest and Cerrado vegetation]
- Plants prostrate, apex of the stems erect; leaves usually congested at the apex of the stems, basal and apical leaves sessile, chartaceous; up to 17 flowers per inflorescence , peduncles up to 10 cm long; anthesis occurring in the morning 6
6. Sepals 4.5–7 mm long, normally glabrous but if pilose then hairs clustered in the apex and never capitate; petals pinkish, obovate (rarely ovate); stamens opposite to the petals with non-moniliform hairs, sterile and elongated anthers sacs, connective not expanded; style nearly as long as the ovary; seeds ribbed *Tripogandra diuretica* (Fig. 4b)
[Brazil, Bolivia, Paraguay, Argentina and Uruguay- in moist lands, from sea level up to 2000 elev.]
- Sepals 2.5–4.6 mm long, normally with capitate hairs (rarely glabrous); petals normally white (rarely pinkish), elliptic to ovate; stamens opposite to the petals with moniliform hairs, anthers sacs fertile and elliptic, connective expanded, sagittate; style half as long or shorter as the ovary; seeds reticulate *Tripogandra serrulata* (Fig. 4g)
[central Mexico to Brazil and Bolivia- in moist environments, from sea level up to 1600 elev.]

Taxonomic treatment

Tripogandra warmingiana (Seub.) Handlos, *Rhodora* 77: 311. 1975. ≡ *Tradescantia warmingiana* Seubert in Warming, *Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn* 126. 1872. (Figs. 1–2)

Lectotype (designated by Handlos 1975):—Brazil. Minas Gerais: Lagoa Santa, 6 March 1866, *E. Warming* 1046 (C photo!).

Herbs annual, terrestrial. *Stems* decumbent, rooting at the nodes; internodes at base 2.5–9.3 cm long, distally shorter, glabrous with a leaf-opposed line of short, uniseriate, whitish hairs. *Leaves* distichous, alternate; sheaths (1.5–)2–6 mm long, margin ciliate; petiole ca. 0.5–5.2 mm long in the basal leaves, indistinct in the upper leaves; leaf blades elliptic to ovate-lanceolate, 1.2–6 × (0.5–)0.7–1.8 cm, fresh leaves slightly discolorous (dark green adaxially, light green abaxially), asymmetric at base, apex acute to acuminate, margin ciliate, midvein oblique, sometimes with a line of hairs in the proximal end. *Inflorescence* 1–2(–4), terminal or sub-terminal; basal bract absent; peduncles (0.3–)0.6–1.5 cm long, green to vinaceous, glabrous; double cincinni 1–3(–8)-flowered, congested; bracts of the cincinnus absent; bracteoles glabrous, margin unequally ciliate. *Flowers* bisexual, zygomorphic due to the position of the stamens, 0.8–1.1 cm diameter, pedicels 3–7 mm long, green to vinaceous, sparsely pilose distally; floral buds ovoid, 3–4 × 1.5–2 mm; sepals concave, ovate, 3–3.5 × 1.3–1.7 mm, equal, margin hyaline, green to vinaceous, externally sparsely pilose, hairs uniseriate, hairs taller and concentrated along the mid-vein, internally glabrous; petals elliptic to ovate, 4.5–5 × 2.3–3 mm, slightly sub-equal, lavender to pink, deliquescent, margin entire to slightly erose; stamens 6, in two whorls; outer whorl opposite to the sepals, pointing downwards, filaments ca. 0.8–1.2 mm long, pinkish, glabrous, anthers ca. 0.5–0.7 × 0.5–0.7 mm, pinkish, rimose, anther sacs elongated, parallel; inner whorl opposite to the petals, pointing upwards, filaments ca. 3–3.7 mm long, white, sigmoid, bearded in the upper portion, hairs white to pinkish, moniliform, anthers ca. 0.2–0.3 × 0.8–1.2 mm, yellow, rimose, connective expanded, elongate, anther sacs elliptic, divergent; ovary globose, ca. 0.9–1 × 0.8–0.9 mm, pinkish, glabrous, smooth, locules 2-ovulate; style ca. 0.4–0.5 mm long, erect, stigma capitate, papillose. *Capsule* globose, dehiscent, ca. 2.5–3 × 2.3–2.8 mm, green to light brown, pedicels reflexed, sepals persistent. *Seeds* round-triangular, ca. 1.2–1.8 × 1.2 mm, gray, testa reticulate-foveate, hilum punctiform.

Specimens examined:—**BRAZIL. Bahia:** Ilhéus, Área do CEPEC (Centro de Pesquisas do Cacau), km 22 da rodovia Ilhéus/Itabuna (BR-415), 30 June 1981, *J.L. Hage 1004 & E.B. Santos* (CEPEC, MBM, US); **Minas Gerais:** Corinto, 3 March 1970, *H. S. Irwin 26860 et al.* (NY, US); *s.l.*, June 1882, *E. Warming s.n.* (K 434014); **Rio de Janeiro:** Niterói, Itaipu, Morro das Andorinhas, 15 January 1982, *D.S. Araújo 477 et al.* (GUA); *loc. cit.*, Itaipu, Morro das Andorinhas, 17 March 2012, *M.O.O. Pellegrini 220 et al.* (RB); *loc. cit.*, Itaipu, trilha da caixa d'água, 17 March 2012, *M.O.O. Pellegrini 223 et al.* (RB).

Additional specimens examined:—**BRAZIL. Minas Gerais:** Lagoa Santa, 10 March 1964, *E. Warming 1070* (C); *loc. cit.*, *s.d.*, *E. Warming s.n.* (P 2189891); *loc. cit.*, *s.d.*, *E. Warming s.n.* (US 2951877).

Distribution:—Bahia, Minas Gerais and Rio de Janeiro states. (Fig. 3)

Habitat:—*Tripogandra warmingiana* occurs in the understory of evergreen and semi-deciduous forests and other moist, shaded habitats in the Atlantic Rainforest and Cerrado vegetation, ca. 50–800 elev. More specifically, it can be found in the Floresta Ombrófila Baixo-Montana, in two localities in Niterói, Rio de Janeiro, and in the Floresta Higrófila, in Ilhéus, Bahia, in addition to the original records for the state of Minas Gerais (municipalities of Lagoa Santa and Corinto, occurring in Floresta de Galeria and in calcareous outcrops).

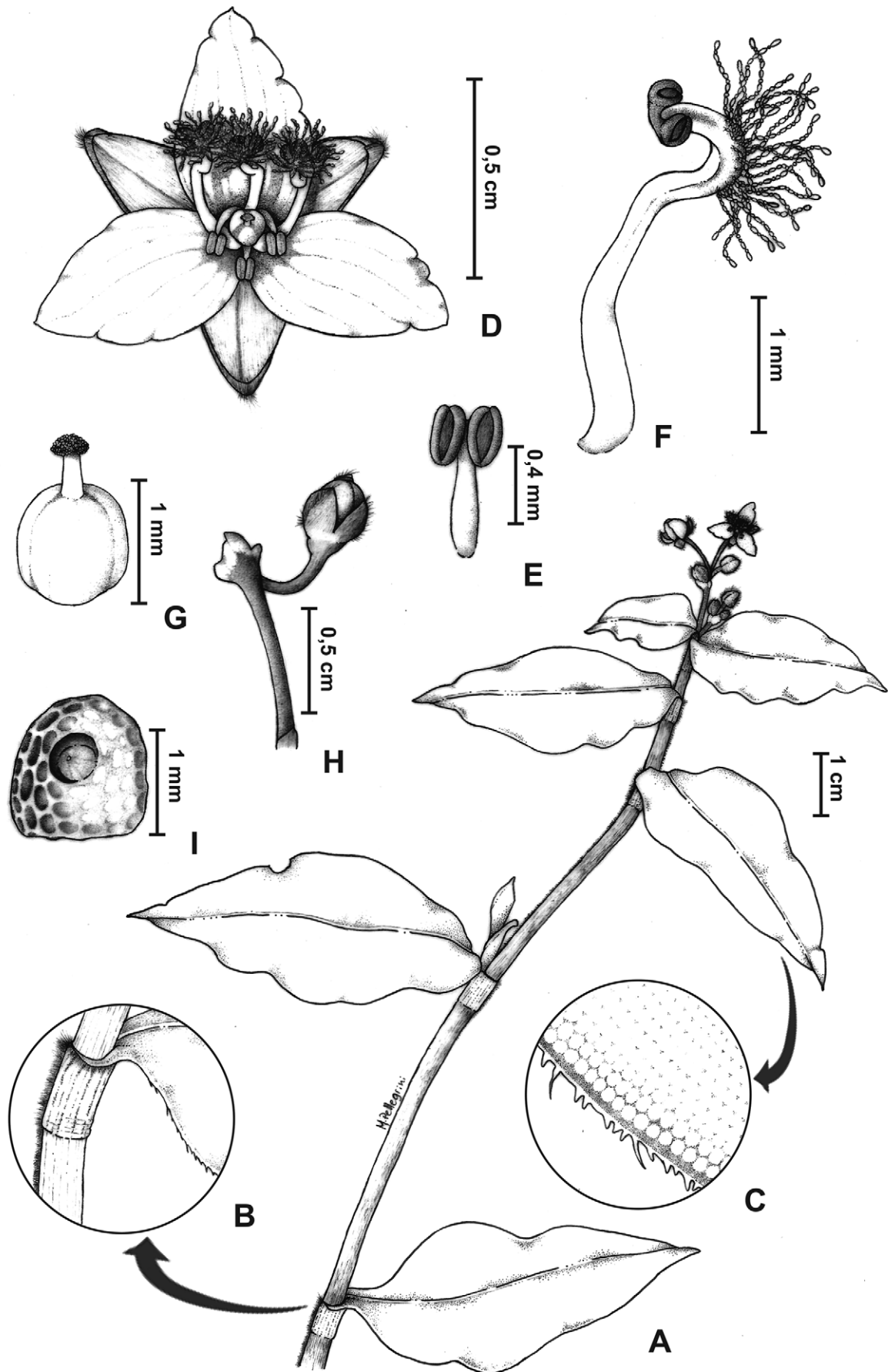


FIGURE 1. *Tripogandra warmingiana*. **A.** Habit. **B.** Indument present on the leaf sheaths (detail). **C.** Ciliate leaf margin (detail). **D.** Flower. **E.** Stamen opposite to the sepal. **F.** Stamen opposite to the petal. **G.** Ovary. **H.** Fruit with reflexed pedicel. **I.** Seed. **A–I** from *M.O.O. Pellegrini 223 et al.* (RB).

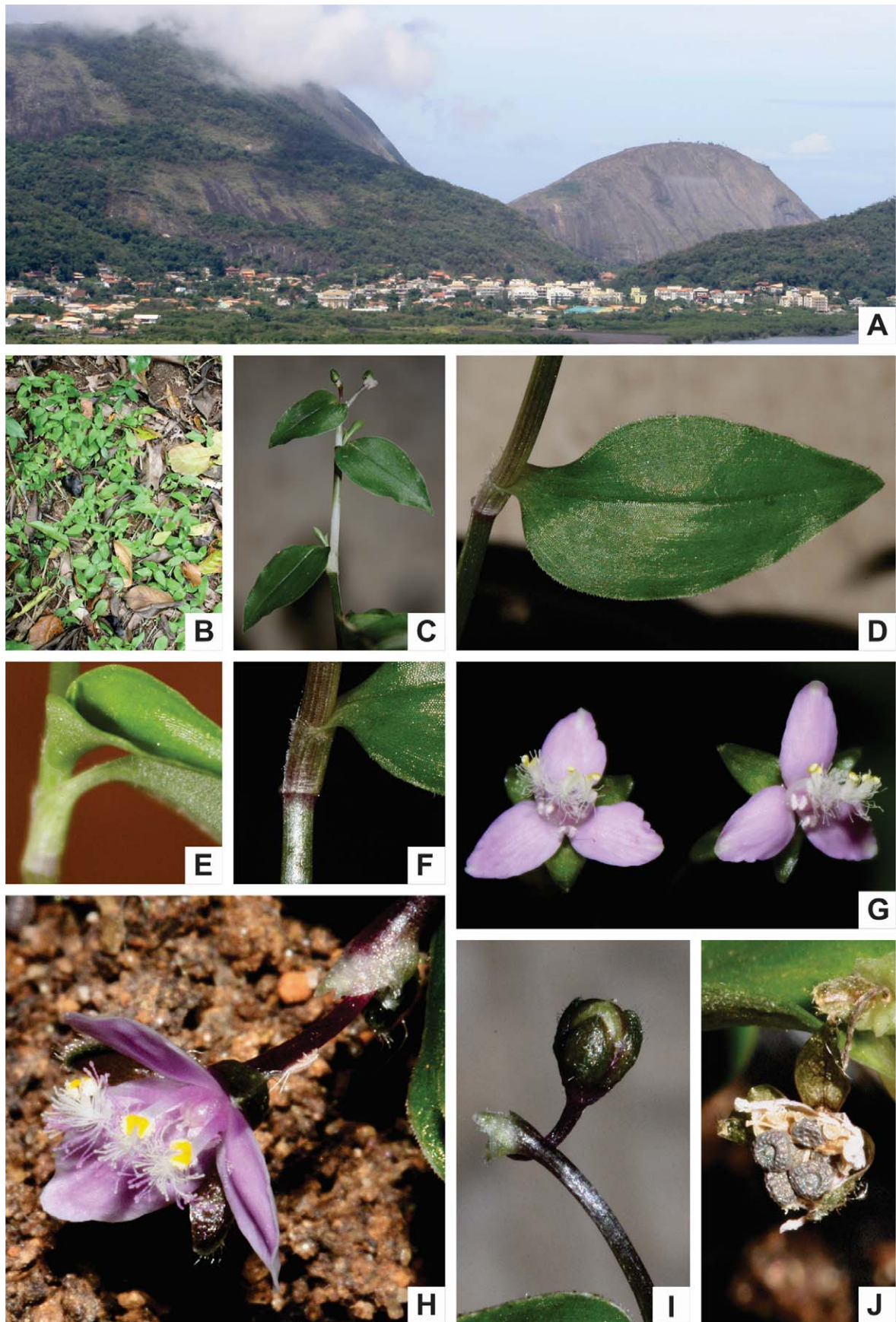


FIGURE 2. *Tripogandra warmingiana*. **A.** Morro das Andorinhas, Itaipú, Niterói, RJ. **B.** Habit. **C.** Stem with young inflorescences. **D.** Front view of the leaf showing the petiole. **E.** Side view of the leaf showing the petiole. **F.** Uniseriate hairs present on the leaf sheaths. **G.** Flowers. **H.** Upper view of a flower showing the uniseriate line of hairs in the sepals, the moniliform hairs in the stamens and the ovary. **I.** Fruit with reflexed pedicel. **J.** Mature fruit with exposed seeds. **A–J** photos by M.O.O.Pellegrini.

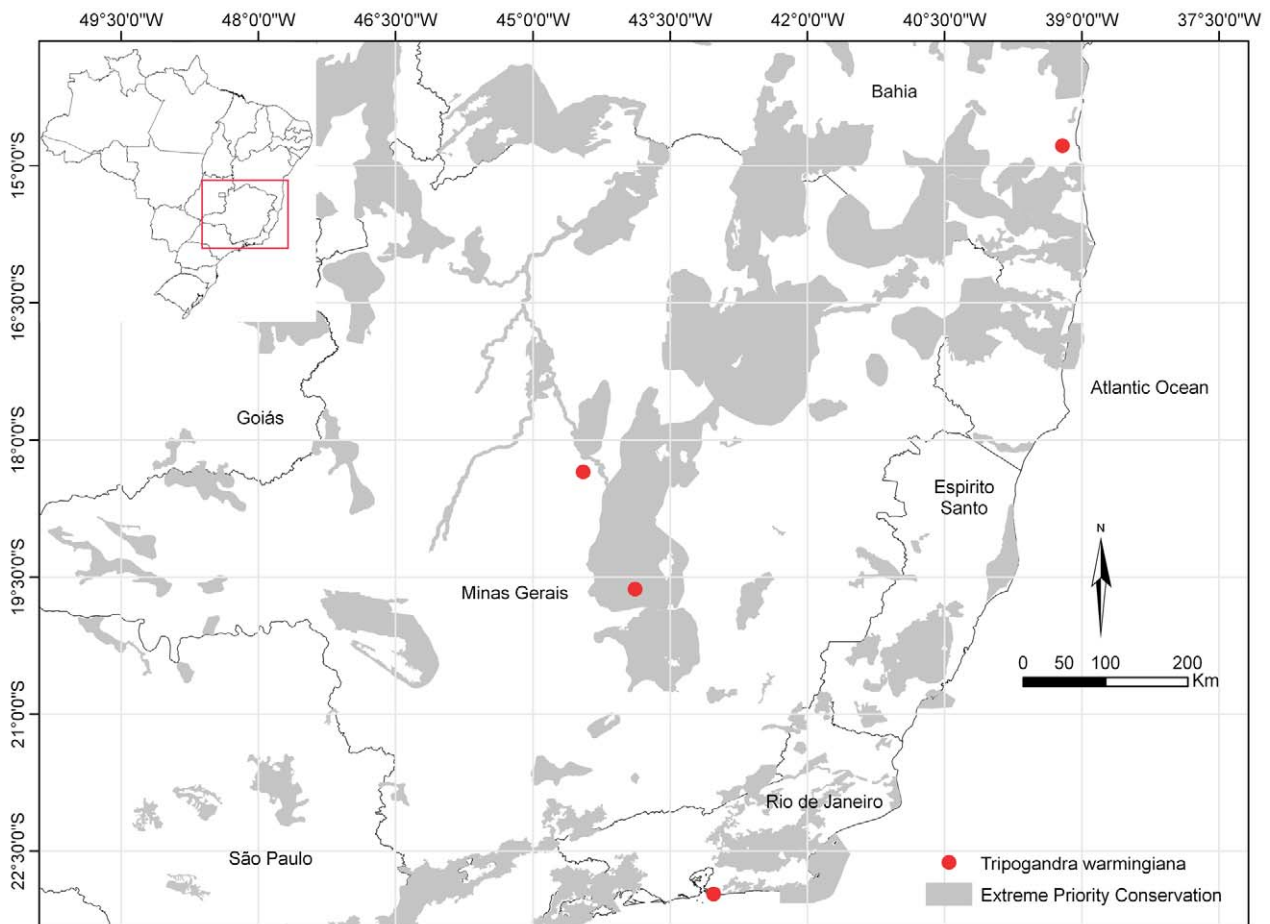


FIGURE 3. Distribution of *Tripogandra warmingiana*. Extreme priority conservation areas in gray (adapted from MMA 2007).

Conservation status:—*Tripogandra warmingiana* is known from only four locations and very small populations. Following recommendations of IUCN (2010), they should be considered Endangered (EN; B2a and D). Only two of the four locations known for this species (Morro das Andorinhas and Lagoa Santa) are inside conservation units (Parque Estadual da Serra da Tiririca and Área de Proteção Ambiental Carste de Lagoa Santa, respectively). Both areas were included by MMA (2007) in the “Atualização das Áreas Prioritárias para Conservação, Uso Sustentável e Repartição de Benefícios da Biodiversidade Brasileira”. Besides that, both the Atlantic Rainforest and the Cerrado are listed as hotspots for conservation due to their highly endemic ecosystems concentrated in very small areas and to depletion of their resources (Myers *et al.* 2000).

Phenology and anthesis:—Flowered specimens were collected or seen from December to June and in fruit from April to July. Differently from the other species of the genus and the family in general, *T. warmingiana* opens its flowers at noon, 13:00h-14:00h. The flowers last for only a few hours, fading between 16:30h and 17:30h. The fruits take about 2 to 3 weeks to mature, progressing from green to light brown.

Common name:—“Marianinha”, according to Hage 1004 & Santos (CEPEC, MBM, US).

Affinities:—*Tripogandra warmingiana* is easily distinguished from other Brazilian taxa of the genus by its creeping and small stature, membranous leaves that are sub-petiolate only at the basal portion of the plant, oblique midvein, extremely small inflorescences with few flowers, diminutive flowers, and small, grey and round-triangular seeds with reticulate testa.

The species is similar to the extremely variable *T. diuretica*, differing mainly in inflorescence and floral characters. In *T. warmingiana* the inflorescence is no longer than 1.2 cm (longer than 2 cm to over 6 cm in *T. diuretica*); petals elliptic to ovate (obovate in *T. diuretica*); and the stamens opposite to the petals with moniliform hairs and presenting elliptic anther sacs with an elongated connective (hairs non-moniliform, elongated and parallel anther sacs and connectives not expanded in *T. diuretica*).



FIGURE 4. *Tripogandra* species native to Brazil. A. *Tripogandra brasiliensis*. B. *Tripogandra diuretica*, detail of the flower. C. *Tripogandra elata*. D–E. *Tripogandra glandulosa*. D. Habit. E. Detail for the flower. F. *Tripogandra neglecta*. G. *Tripogandra serrulata*, habit. A G. Eitten & L.T. Eitten 4456, Isotype, (US). B & E photos by M.O.O.Pellegrini. C H.S. Irwin 15692 et al. (P). D photo by Greta Dettko. F E. Warming s.n. (P 2189811). G photo by Robert B. Faden.

This species is also similar to *T. serrulata*, a widely distributed species with few collections for the Brazilian territory. They can be distinguished by its creeping habit (vs. creeping at the basal portions and erect at the apex of the stems in *T. serrulata*); small sub-petiolate leaves no longer than 4.5 cm (vs. leaves longer and always sheathing in *T. serrulata*); 1–3 inflorescences per stem with 1–8 flowers (vs. 1–13 inflorescences with up to 17 flowers per double cincinnus in *T. serrulata*); sepals with uniseriate hairs (when present, hairs always capitate in *T. serrulata*); and elongated connective (vs. sagittate connective in *T. serrulata*).

Nomenclatural notes:—In the protologue of *Tradescantia warmingiana*, Seubert gives little information on examined material used in the new species description, saying just: “*Cescit parce in silvis imprimis super rupibus calcareis sitis ad Lagoa Santa; floret M. Jan.–Mart.: Warming*”, giving no specifications on the collectors number, date or the herbarium where this material is deposited. Handlos (1975) indicates the material *Warming 1046* (C) as the holotype of *Tradescantia warmingiana* (\equiv *Tripogandra warmingiana*), effectively lectotypifying that specimen (ICBN, Art. 7.11). However, no justification or explanation was provided for the process of selecting the lectotype.

The two specimens from C (*Warming 1046 e 1070*) were collected in March, although the flowering period given by Seubert is from January to March, which indicates that the author also analyzed other specimens. Nevertheless, none of the examined “*Warming s.n.*” materials deposited in the consulted herbaria were collected in January.

Examining Seubert’s manuscript as a whole, the author mentioned collector numbers for the materials of the remaining species so we conclude that when he mentioned just “*Warming*” (not *Warming s.n.*), he was referring to all the collections made by Warming in the type locality (Lagoa Santa) until 1872 (the year of Seubert’s publication). Thus, the materials deposited in the herbaria C, P and US are here recognized as part of the original material. Also the material deposited in K cannot be considered as part of the original material, despite being a *Warming s.n.* collection, since it was collected after *Tradescantia warmingiana* was published. The material cited by Handlos (1975) for the F herbarium consists of a photograph of the lectotype, deposited in C, and therefore should not be treated as part of the original material.

Conclusion

The small number of species of many genera of plants, present in the “Lista da Flora Brasileira Ameaçada de Extinção” (List of the Threatened Brazilian Flora) [Fundação Biodiversitas 2009] and “Lista Oficial das Espécies da Flora Brasileira Ameaçadas de Extinção” (Official List of the Threatened Species of the Brazilian Flora) [MMA 2008] is due largely to the lack of specialists and dearth of recent taxonomic revisions on these groups. As with many other taxa of Commelinaceae, *Tripogandra warmingiana* has been overlooked throughout the past years in part because of its small stature and lack of economic importance. These factors contributed for the poor knowledge of this species and the lack of a proper conservation status.

Almost no efforts were made in the recent years to recollect the many obscure taxa in the family, with the exception of species of *Dichorisandra*, which received special attention during the revision of the genus by Aona (2008). Because of the enormous number of species, Barreto (1997) was unable to recollect and provide significantly improved taxonomic treatments to the problematic taxa. Despite our efforts, *Tripogandra* is still proportionally one of the most problematic in Brazil, with 3 out of 7 species still poorly known and infrequently collected. For example, *Tripogandra brasiliensis* Handlos (1975: 253) and *T. elata* are still known from only a few historical collections, whereas *T. neglecta* is still known only from the type collection. *Aneilema*, *Buforrestia* C.B. Clarke (1881: 120), *Callisia* Loefling (1758: 305), *Murdannia* Royle (1839: 403) and *Tinantia* Scheidweiler (1839: 365) are the genera most critically in need of taxonomic revision, given that nearly all of the species recorded for Brazil have few to no recent collections. *Tradescantia* also needs taxonomical revision to clarify specific boundaries within sect. *Austrotradescantia*. In addition, *Siderasis Rafinisque* (1836: 67) needs to have its status as a monotypic genus reevaluated.

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