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## *Drosera quartzicola* (Droseraceae), a new and threatened species from the Serra do Cipó, Brazil

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### Abstract

*Drosera quartzicola* (Droseraceae), a new species from the Serra do Cipó highlands, Minas Gerais state, southeastern Brazil, is described here. The morphological characters that distinguish it from similar *Drosera* species are discussed, together with habitat information, detailed illustrations, and its conservation status. A key to the *Drosera* species of the Serra do Cipó is provided.

### Resumo

*Drosera quartzicola* (Droseraceae), uma nova espécie da Serra do Cipó, Minas Gerais, sudeste do Brasil, é aqui descrita. Os caracteres morfológicos que distinguem essa nova espécie de táxons similares são discutidos junto com informações sobre habitat, ilustrações detalhadas e seu *status* de conservação. Uma chave de identificação para as espécies de *Drosera* da Serra do Cipó é apresentada.

**Key words:** campo rupestre, carnivorous plants, IUCN Red List, Minas Gerais

### Introduction

The Serra do Cipó highlands (part of the greater Cadeia do Espinhaço highlands) in central Minas Gerais state, southeastern Brazil, became the focus of numerous studies by the Botany Department of the University of São Paulo and other institutions. These studies were initiated in the latter half of the 20th Century, because then it was realized this area harbored an enormous biodiversity. As a result, the Serra do Cipó National Park was created in 1975 and these highlands are now one of the most thoroughly botanized areas of Brazil.

In a floristic study of the Serra do Cipó, Silva (1999) identified only three species of *Drosera* L.: *D. chrysolepis* Taubert (1893: 505), *D. communis* Saint-Hilaire (1824: 1), and *D. montana* Saint-Hilaire (1824: 260), the latter including *D. montana* var. *montana*, *D. montana* var. *tomentosa* (A.St.-Hil.) Diels (1906: 89), *D. montana* var. *hirtella* (A.St.-Hil.) Diels (1906: 89), and *D. montana* var. *schwackei* Diels (1906: 89). Rivadavia (2003) added three new species of *Drosera* native to the Serra do Cipó: *D. camporupestris* Rivadavia (2003: 85), *D. grantsau* Rivadavia (2003: 82) and *D. tentaculata* Rivadavia (2003: 79).

Based on morphological data, Santos (1989) corroborated the species status for *D. hirtella* Saint-Hilaire (1824: 262). Rivadavia *et al.* (2003) and Rivadavia (2005) added support from molecular phylogenetic reconstructions and karyotype data for a closer tie between *D. hirtella* and *D. communis*, as these two species are found in a clade of mostly diploid species, whereas *D. montana* is included in a tetraploid clade. Rivadavia

(2008) proposed the new status of *D. schwackei* (Diels) Rivadavia (2008: 36), based on molecular, ecological and morphological data. Based on similar data (including Rivadavia *et al.* 2003 and Rivadavia 2005) we furthermore here accept *D. tomentosa* Saint-Hilaire (1824: 261) at species rank.

While studying herbarium specimens of *Drosera* species from the Serra do Cipó in the early 1990's at the Universidade de São Paulo Herbarium (SPF), a unique new taxon was identified. Location data was vague and several excursions to the Serra do Cipó were necessary before this new taxon was rediscovered in 1996. Further explorations uncovered additional populations of the new taxon, allowing a more in-depth study.

## Taxonomic Treatment

### *Drosera quartzicola* Rivadavia & Gonella, *sp. nov.* (Figs. 1, 2, 3 & 4)

*Drosera chrysolepis* affinis, sed caulis brevis ad 4 cm longis, petiolis laminis aequantibus vel paulo brevioribus, in laminas continuos, pilis eglandulosus tantum in pagina foliorum inferiore, et scapis brevioribus differt.

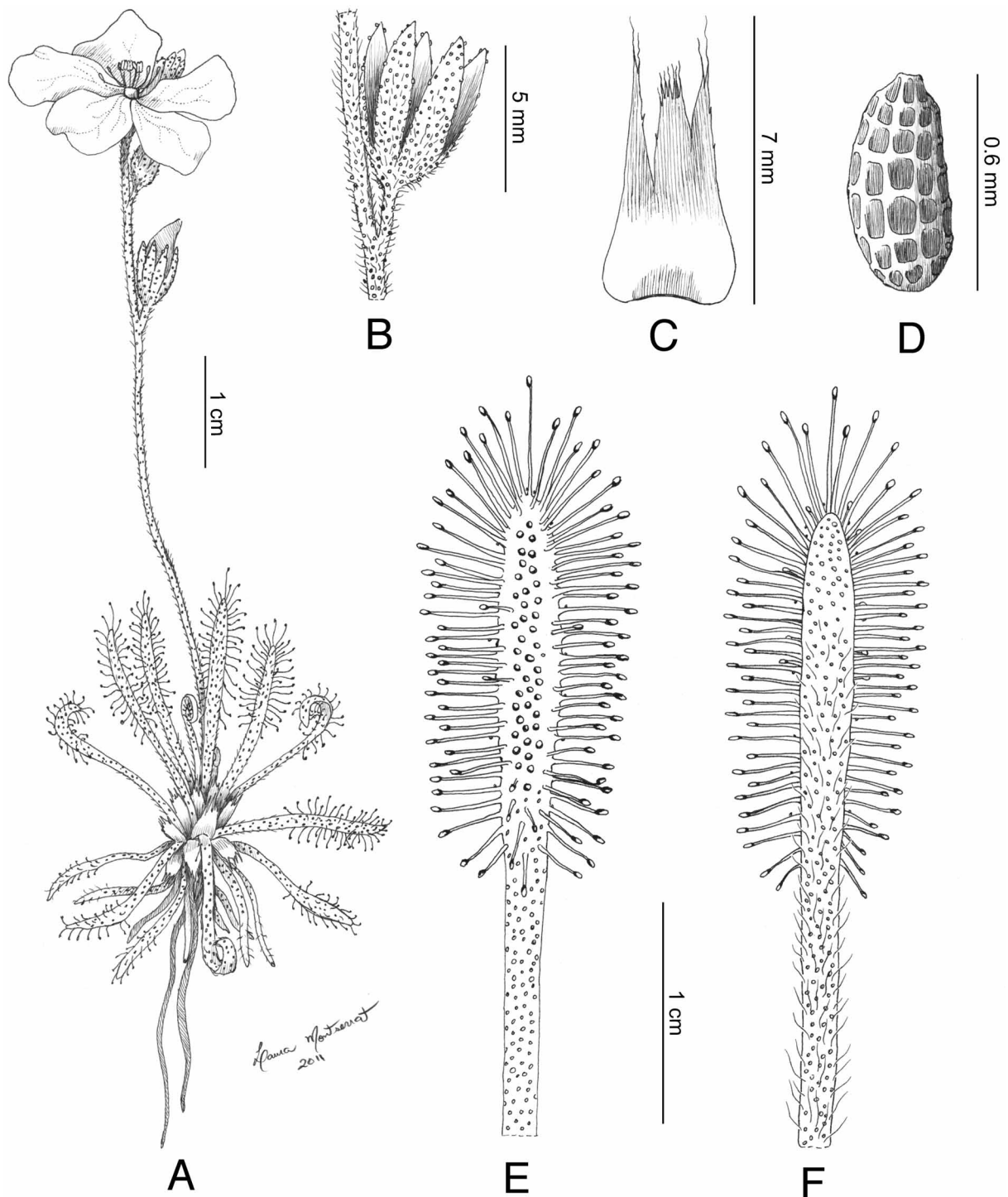
Holotype:—BRAZIL: Minas Gerais: Santana do Riacho, km112-113 da estrada para Conceição do Mato Dentro (MG-10), em morro após bifurcação da trilha para o Travessão e cachoeira Congonhas, seguindo à esquerda, 1360 m, 19 April 2010, *P. M. Gonella et al.* 264 (SPF).

Perennial rosetted herbs, acaulescent, sometimes forming short stems covered by the persistent dead leaves, up to 4 cm high; white eglandular hairs 0.5–3.0 mm long, present on leaves (abaxially, denser and longer towards the base), scapes, pedicels, and sepals (abaxially); minute sessile glands c. 0.03 mm diam., sparsely present on leaves (abaxially and adaxially), scapes, pedicels, and sepals (abaxially); translucent-yellow short-stalked multicellular globose trichomes (from here on referred to as 'TSG' trichomes) 0.10–0.15 mm in diameter present on lamina (abaxially), petioles (adaxially and abaxially), pedicels, and sepals (abaxially). *Stipules* triangular, membranaceous, 6–8 mm long, 1.5–3.0 mm wide at the base, bronze-gold in color, the apical  $\frac{1}{2}$ – $\frac{1}{3}$  divided into 2–3 long lacinate segments with fimbriate apex. *Leaves* with circinate vernation, semi-erect, patent when old, lanceolate, (7–)10–40 mm long; *petioles* (3.5–)5–20 mm long, 0.8–2.4 mm wide, yellowish-green to red in color; *lamina* (3.5–)5–20 mm long, 1.2–2.5 mm wide, yellowish-green to red in color, adaxial surface covered with numerous red, carnivorous, capitate tentacles. *Scapes* 1–2(–3) per plant, erect or slightly curved at the base, apex often bifurcate, 1.7–11.5 cm long; *inflorescence* a scorpioid cyme, bearing 1–9(–11) flowers; *bracts* filiform-lanceolate, 1.5–3.6 mm long, usually absent; *pedicels* 1.5–6 mm long, inserted 3.6–15.0 mm apart from each other; *sepals* 5, oblong-lanceolate to lanceolate, 2.5–7.5 mm long, 0.7–2.0 mm wide, united at basal  $\frac{1}{3}$ – $\frac{1}{4}$  of length; *petals* 5, obovate, 5.5–10.1 mm long, 4.5–7.0 mm wide, pink-lilac in color; *stamens* 5, 3–4 mm long, anthers 1.0–1.7 mm long, bithecate, yellow; *ovary* 3-carpellate, ellipsoid, 1.5–2.0 mm in diameter at anthesis, slightly 3-lobed in outline; *styles* 3, forked at the base, 3–4 mm long (including stigmata), stigmata flabellate, pink-lilac to dark pink in color; *fruit* a dry capsule, ellipsoid, 2.5–3.0 mm long, 3-valvate; *seeds* narrowly oblong-ovate, 0.7–0.8 mm long and c. 0.3 mm wide, testa reticulate, black.

**Distribution and ecology:**—*Drosera quartzicola* is endemic to the Serra do Cipó in central Minas Gerais state, southeastern Brazil. It was observed growing sympatrically with *D. tentaculata* and *D. chrysolepis* in 'campo rupestre' vegetation, where it seems to have the same ecological niche occupied further north along the Cadeia do Espinhaço by *D. schwackei*. Both *D. quartzicola* and *D. schwackei* grow in small populations in fine silica sand mixed with white quartz gravel among sparse grasses and sedges (Fig. 2C), often concentrated along a borderline habitat, where mounds or hillsides with this soil meet flatter sandier areas. This habitat is usually humid from constant rainfalls during the summer wet season, but in winter it becomes very dry when compared to other seasonal habitats occupied by *Drosera* species in Brazil.

The rosettes of *D. quartzicola* (similar to those of *D. schwackei*) lose vigor during the winter dry season. With decreasing soil moisture, the leaves become reduced in length, curl inwards, and the sticky carnivorous

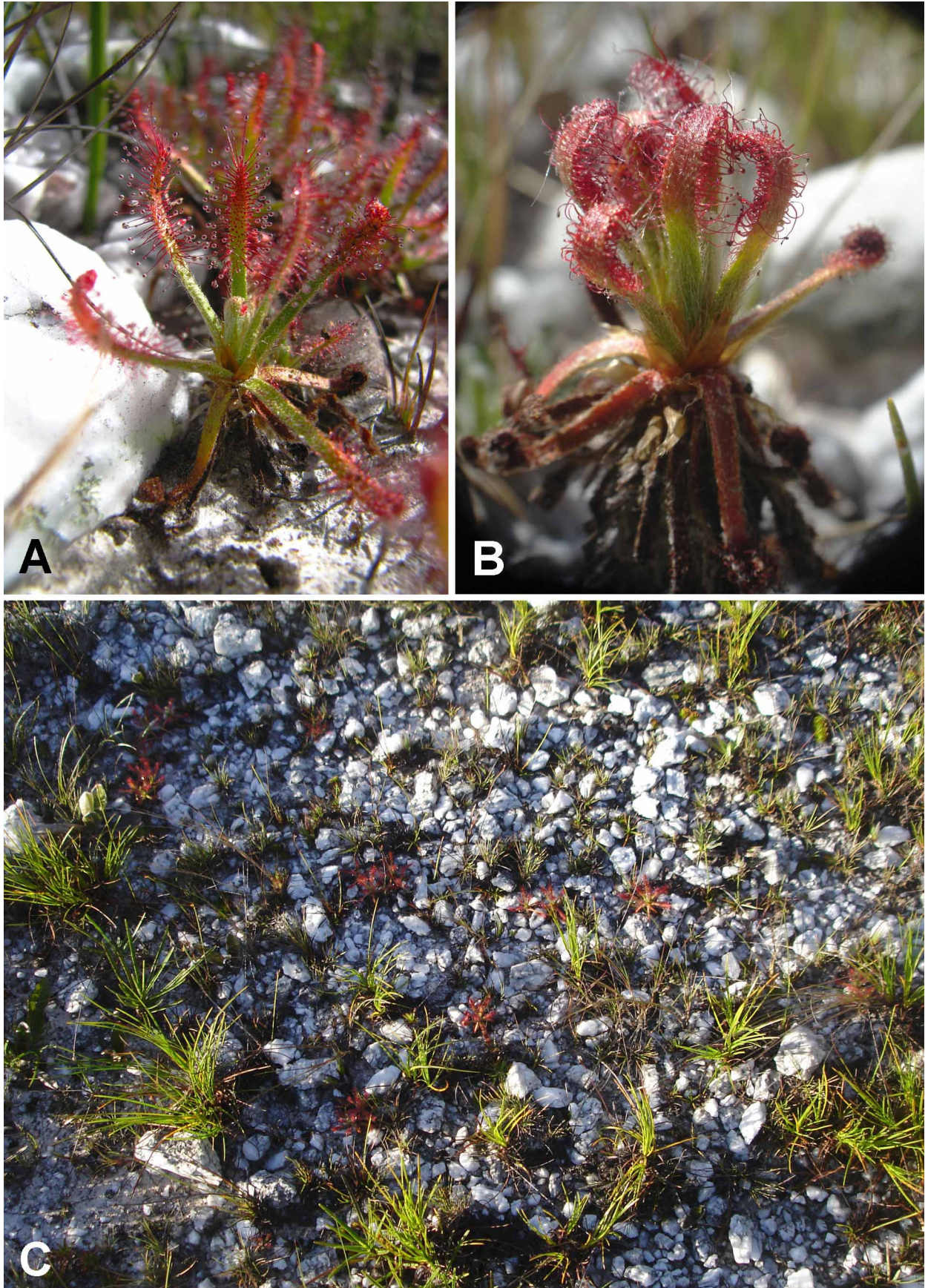
tentacles may even lose their mucilage (Fig. 2B). The main source of water during the winter is probably from dew, which condenses on the tentacles, eglandular hairs, and TSG trichomes.



**FIGURE 1:** *Drosera quartzicola* Rivadavia & Gonella. **A.** Habit. **B.** Calyx. **C.** Stipule. **D.** Seed. **E.** Leaf, adaxial surface. **F.** Leaf, abaxial surface. Based on the holotype.

The semi-erect leaves of *D. quartzicola* were observed in the field to capture mostly flying insects, such as small flies and mosquitoes (Diptera).

**Phenology:**—As a result of its preference for drier habitats, *D. quartzicola* flowers very early in the wet season, from January to February, although a few individuals have been collected with flowers in April.



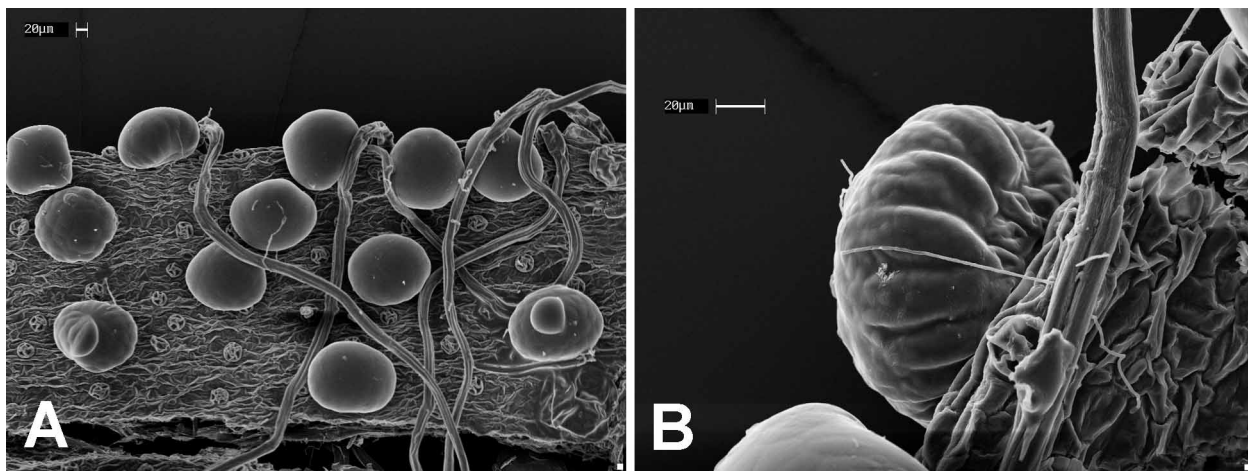
**FIGURE 2.** *Drosera quartzicola*. **A.** View of a rosette towards the end of the wet season (April). **B.** View of a rosette at the start of the dry season, with leaves curved inwards (July). **C.** View of the habitat, silica sand mixed with white quartz gravel. A by F. Rivadavia; B & C by P. M. Gonella.



**FIGURE 3.** *Drosera quartzicola*. **A.** Front view of the flower. **B.** Close-up of the front view of the flower, detail of the reproductive organs. **C.** Close-up of the flower bud, showing the dense indumentum of eglandular hairs and translucent-yellow short-stalked globose ('TSG') trichomes. **D.** Close-up of the adaxial surface of the petiole, showing the large number of TSG trichomes. Photos by P. M. Gonella.

**Etymology:**—The epithet “*quartzicola*” denotes the characteristic habitat of this new species, occurring in silica sand mixed with white quartz gravel.

*Drosera quartzicola* belongs to *Drosera* subgen. *Drosera* sect. *Drosera* (*sensu* Seine & Barthlott 1994) and superficially resembles *D. schwackei*, with which it shares similar leaf shape and size, heavy eglandular pubescence on the abaxial leaf surface, abundance of TSG trichomes, and relatively large oblong-ovate seeds with similar ornamentation. All this suggests a possible close relationship between *D. quartzicola* and *D. schwackei*, or else a convergence of ecological adaptations to strikingly similar habitats. *Drosera schwackei* can be readily distinguished by its shorter rectangular stipules (1–4 mm long), and further by its oblong-lanceolate leaves, which are usually shorter (up to 22 mm) and wider (up to 4 mm), longer scapes (6–18 cm in length), its more compact and yellowish rosettes, shorter petioles (up to 5 mm), eglandular hairs present on the adaxial surface of petioles, and smaller TSG trichomes c. 0.05 mm in diameter (0.10–0.15 mm in *D. quartzicola*).



**FIGURE 4.** SEM micrographs of the translucent-yellow short-stalked globose (“TSG”) trichomes and the minute sessile glands of *Drosera quartzicola*. **A.** Adaxial surface of the petiole with multiple TSG trichomes (the ones on the left showing a somewhat moriform shape) and minute sessile glands; **B.** Lateral view of a single TSG trichome and smaller sessile gland. Micrographs provided by A. Fleischmann.

Notwithstanding the above similarities with *D. schwackei*, *D. quartzicola* is probably most closely related to (and in many ways resembles a morphologically reduced specimen of) *D. camporupestris*, *D. graminifolia* Saint-Hilaire (1824: 269), and especially *D. chrysolepis*. Similar to *D. schwackei*, these taxa share characters such as TSG trichomes (Figs. 3D, 4A & B) and relatively large oblong to ovate seeds with similar ornamentation, but *D. schwackei* does not possess the unusually large bronze-colored triangular stipules found in the other four species. *Drosera quartzicola* is morphologically most similar and possibly most closely related to *D. chrysolepis*, with which it has even been observed to form natural hybrids at one population. *Drosera quartzicola* can be easily distinguished from *D. camporupestris*, *D. chrysolepis*, *D. graminifolia*, and *D. schwackei* when in flower by its much shorter inflorescences, possibly an adaptation to the more exposed and drier montane habitats where it occurs.

The TSG trichomes observed in *D. quartzicola*, *D. schwackei*, *D. camporupestris*, *D. chrysolepis*, and *D. graminifolia*, are also present in *D. meristocaulis* Maguire & Wurdack (1957: 332) (*Drosera* sect. *Meristocaulis*) native to Venezuela, and in some members of the so-called ‘pygmy *Drosera*’ (*Drosera* sect. *Bryastrum*), of Australia and New Zealand. It appears that the TSG trichomes are not secretory in nature, but are hygroscopic organs used by the above species (which inhabit relatively very dry habitats for *Drosera*) to absorb humidity from the air. When air humidity is low, the TSG trichomes appear to be slightly moriform, but in more humid conditions become globose and smooth when intumescend, and even appear to collect water at the apex, resembling a glandular trichome (A. Fleischmann, personal communication). The TSG trichomes

resemble smaller versions of the moriform trichomes found on the petioles of *D. hartmeyerorum* Schlauer (2001: 104) from northern Australia, and may be homologous with these.

*Drosera quartzicola* is the rarest of the known sundews native to Brazil. Although extensive searches have been carried out, it is still only known from four small populations in the Serra do Cipó highlands. Three of these populations are found at an elevation of about 1350 m and contain approximately 60, 100 and 120 plants, whilst the fourth is located at an elevation of 1100 m and contains approximately 20 individuals.

The *D. quartzicola* populations with c. 60 and 100 individuals are barely within the borders of the Serra do Cipó National Park, and the latter of these two is unfortunately located on the margins of a touristic trail, which is a source of erosion and invasion of exotic grasses (such as *Melinis* and *Brachiaria* species) usually associated with cattle, that frequently cross into the park in this area. The largest population (with c. 120 plants) is found just outside the park, also in an area with the occasional presence of cattle. The smallest *D. quartzicola* population (with c. 20 plants) is located outside the park, approximately six kilometers north of the other three populations.

Based on the IUCN criteria (IUCN 2001), we hereby propose to list *D. quartzicola* as “Critically Endangered”, due to its restricted occurrence in an area estimated to be less than 100 km<sup>2</sup>, the projected decline in the quality of the habitat, and the small total population size.

**Additional specimens examined (paratypes):**—BRAZIL. Minas Gerais: Santana do Riacho, km 115 da estrada para Conceição do Mato Dentro, 12 March 1993, *Silva CFCR 13035* (SPF); Santana do Riacho, km 112-113 da estrada para Conceição do Mato Dentro, em morro após bifurcação da trilha para o Travessão e cachoeira Congonhas, seguindo à esquerda, 22 February 1996, *Rivadavia & Mullins 542* (SPF), 22 July 2008, *Gonella et al. 151* (SPF), 6 April 2009, *Gonella et al. 222* (SPF); Santana do Riacho, km 112-113 da estrada para Conceição do Mato Dentro, em morro à esquerda logo no início da trilha para o Travessão e cachoeira Congonhas, 25 February 1997, *Rivadavia & Pinheiro 555* (SPF), 12 September 1999, *Rivadavia 1163* (SPF), 28 July 2002, *Rivadavia & Gibson 1359* (SPF), 29 January 2005, *Rivadavia 1938* (SPF), 20 July 2008, *Gonella et al. 132* (SPF), 6 April 2009, *Gonella et al. 218* (SPF); Santana do Riacho, após acampamento Serra Morena, 7 September 2002, *Rivadavia 1412* (SPF), 29 January 2005, *Rivadavia 1936* (SPF); Santana do Riacho, km 112-113 da estrada para Conceição do Mato Dentro, em morro à direita logo no início da trilha para o Travessão e cachoeira Congonhas, 4 April 2003, *Rivadavia 1544* (SPF), 20 July 2008, *Gonella et al. 133* (SPF), 6 April 2009, *Gonella et al. 224* (SPF).

## Key to the *Drosera* of the Serra do Cipó, Minas Gerais State

1. Plants with leaves lanceolate to oblong-lanceolate, with acute apex ..... 2
  - Plants with leaves oblong, obovate, oblanceolate, cuneate or spatulate, with obtuse or truncate apex ..... 5
2. Plants with petioles graduating continuously into lamina, the petiole shorter or as long as the lamina ..... 3
  - Plants with petioles distinct, narrower and longer than the lamina ..... 4
3. Plants with rectangular stipules 1–4 mm long, leaves 6–22 mm long, petioles much shorter than the lamina, 1–5 mm long, with eglandular hairs covering both adaxial and abaxial surfaces, inflorescences 6–18 cm long....*D. schwackei*
  - Plants with triangular stipules 6–8 mm long, leaves (7–)10–40 mm long, petioles as long as the lamina, (3.5–)5–20 mm long, with eglandular hairs covering only the abaxial surface, inflorescences 1.7–11.5 cm long....*D. quartzicola*
4. Plants with stems 5.0–46.5 cm long, visible internodes, numerous functional leaves, petioles ≤45 mm long, stipules ≤10 mm long ..... *D. chrysolepis*
  - Plants with stems 0.5–3.0 cm long, internodes not visible, only 1–2 (rarely 3) functional leaves per plant, petioles 25–105 mm long, stipules 7–13 mm long..... *D. camporupestris*
5. Plants with semi-erect leaves, sometimes forming a long and visible stem, seeds fusiform..... 6
  - Plants with leaves adpressed to the ground, acaulescent or forming a short column of accumulated dead leaves, seeds ovoid ..... 7
6. Plants with obovate to oblanceolate leaves, flower scapes with pronounced curve at the base (ascending), sometimes forming long stems when growing in semi-aquatic habitats ..... *D. communis*
  - Plants with spatulate-linear leaves, flower scapes erect at the base, forming stems 1–28 cm in length even in drier habitats ..... *D. grantsauii*



7. Petioles representing about half of total leaf length, much narrower than the lamina, flower scape ascending at the base, densely covered with red eglandular hairs at basal two thirds of length ..... *D. hirtella*
- Petioles much shorter than and graduating continuously into the lamina (representing about a quarter of total leaf length), flower scape erect at the base and glabrous to densely covered with white eglandular hairs ..... 8
8. Leaves obovate-cuneate with 7–12 well-developed apical tentacles with bilateral symmetry 4–9 mm long, with a long rectangular-linear head 0.7–1.2 mm long ..... *D. tentaculata*
- Leaves oblong, obovate or oblong-spatulate, bilateral symmetric tentacles lacking or, if present, only up to 5 mm long, with head only up to 0.6 mm long ..... 9
9. Plants usually blooming during summer and fall, leaves oblong to oblong-spatulate, glabrous to sparsely pilose abaxially, petioles 0.2–0.5 mm wide, sepals 2–6 mm long and 0.8–2.0 mm wide ..... *D. montana*
- Plants usually blooming during winter and spring, leaves obovate to oblong-obovate, sparse to densely pilose abaxially, petioles 0.4–3.0 mm wide, sepals only up to 3 mm long and up to 1.3 mm wide ..... *D. tomentosa*

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