



## Flora of Espírito Santo, Brazil

### Flora of Espírito Santo: Droseraceae

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#### Abstract

We present a taxonomic treatment of the species of Droseraceae in Espírito Santo state, Brazil. Droseraceae is represented in the state by two species: *Drosera intermedia*, found in marshlands in the *restingas* (pioneer formations), and *Drosera latifolia*, which occurs in the campos de altitude (ecological refuges) and on granitic inselbergs in areas of ombrophilous forest in the mountainous region of Espírito Santo. We provide an identification key, morphological descriptions, and commentaries on taxonomy, ecology, conservation, and geographical distribution.

**Key words:** Atlantic Forest, carnivorous plants, *Drosera*, inselbergs, *restingas*.

#### Resumo

Apresentamos o tratamento taxonômico das espécies de Droseraceae para o Espírito Santo. Droseraceae está representada no estado por duas espécies: *Drosera intermedia*, encontrada em locais brejosos nas *restingas* (formações pioneiras), e *Drosera latifolia*, que ocorre nos campos de altitude (refúgios ecológicos) e em inselbergues graníticos inseridos em áreas de floresta ombrófila da região serrana do Espírito Santo. Fornecemos chave de identificação, descrições morfológicas, comentários taxonômicos, ecológicos, de conservação e de distribuição geográfica.

**Palavras-chave:** Mata Atlântica, plantas carnívoras, *Drosera*, inselbergs, *restingas*.

#### Introduction

Droseraceae (non-core Caryophyllales, Eudicots) is a family of carnivorous herbs composed of three genera and around 250 species (Fleischmann *et al.* 2018). *Dionaea* and *Aldrovanda* are monotypic and do not occur naturally in Brazil but are cultivated in the country by enthusiasts. On the other hand, *Drosera* is a cosmopolitan genus that contributes most species to the family, with centers of diversity in Australia, Brazil, and South Africa. Brazil, in particular, is home to 31 species, one nothospecies, and two varieties, of which 19 species are endemic to the country (Gonella 2020; Flora do Brasil 2020).

The genus is characteristic of open formations and is often associated with quartzitic and oligotrophic soils that are, at least, seasonally wet

(Juniper *et al.* 1989; Fleischmann *et al.* 2018). *Drosera* is a characteristic element of the endemic flora of the Brazilian montane grasslands called *campos rupestres* (Colli-Silva *et al.* 2019) and is usually absent from forest formations, except for a few species that can be found occurring in riverine forests (Gonella 2020).

The state of Espírito Santo is entirely located within the Atlantic Forest Domain, with an original cover of ombrophilous and seasonal semideciduous forests, in addition to pioneer formations such as vegetation in the coastal plains (*restingas*) and ecological refuges for higher-altitude flora in the montane grasslands of Serra do Caparaó (Garbin *et al.* 2017). Despite having some of the greatest floristic diversity of any Brazilian state (Dutra *et al.* 2015; BFG 2018), only 12.6% of its original

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vegetation cover remained (Fundação SOS Mata Atlântica & INPE 2019), highlighting the relevance and urgency of floristic inventories, taxonomic treatments, and conservation efforts.

This study is part of the Flora of Espírito Santo Project and aims at presenting a taxonomic treatment for the Droseraceae occurring in the state and to provide an identification key and descriptions, along with commentaries on taxonomy, ecology, conservation, and geographical distribution.

### Material and Methods

Descriptions and phenological data were based on specimens studied in the field and herbarium specimens, complemented by information in the literature. Specimens held at the herbaria HB, MBML, MO, NY, R, RB, US, and VIES were studied in person, while one specimen from the GH herbarium was analyzed at the institution's virtual herbarium, available at <[https://kiki.huh.harvard.edu/databases/specimen\\_index.html](https://kiki.huh.harvard.edu/databases/specimen_index.html)> (acronyms according to Thiers, continuously updated). The morphological terminology used in the species descriptions follows Gonella *et al.* (2014, 2015), Rivadavia *et al.* (2014), and Fleischmann *et al.* (2018).

Following a recent reassessment of the Red List conservation status of the species in Espírito Santo (Fraga *et al.* 2019), the Droseraceae species discussed in this paper had their regional conservation status newly assessed based on new data on their geographical distribution in the state. The assessment follows the IUCN (2012a) categories and criteria, including the IUCN (2012b) guidelines for regional assessments. We used the conservation assessment tool GeoCAT (available at <<http://geocat.kew.org/>>) to calculate the extent of occurrence (EOO) and area of occupancy (AOO) as described in Bachman *et al.* (2011) using the standard IUCN cell size of 4 km<sup>2</sup> for the AOO estimation.

### Results and Discussion

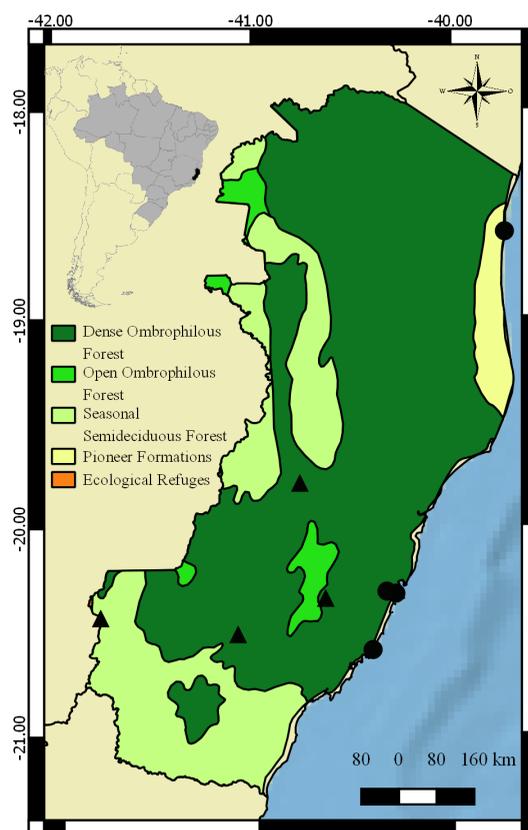
In Espírito Santo, Droseraceae are represented only by two species of the genus *Drosera*. *Drosera intermedia* Hayne in Dreves & Hayne (1798: 18) occurs in wet areas of the *restingas* (Fig. 1). In contrast, *D. latifolia* (Eichler 1872: 395) Gonella & Rivadavia in Gonella *et al.* (2014: 20) is a rupicolous species found in montane grasslands and on granitic rock outcrops (inselbergs; Fig. 1).

Three *Drosera* species have been previously reported for Espírito Santo. Valadares *et al.* (2020) recorded *D. intermedia* in an area of marshland in the restinga. Silva & Giulietti (1997) and Correa & Silva (2005) reported *D. villosa* A.Saint-Hilaire (1824: 2607), though these records were reclassified as *D. latifolia* by Gonella *et al.* (2014). A record of *D. montana* A.Saint-Hilaire (1824: 260) was listed by Dutra *et al.* (2015) based on the voucher *Ynês Mexia 40251* (GH, MO), but that is also *D. latifolia*.

*Drosera montana* is recorded from the Minas Gerais side of the Serra do Caparaó (Rivadavia *et al.* 2014; Moreira *et al.* 2020). However, no specimens have been found on the Espírito Santo side thus far.

### Droseraceae Salisb.

Annual or perennial carnivorous herbs. Stem inconspicuous or elongated. Leaves simple, stipules present or absent, vascularized glandular



**Figure 1** – Geographic distribution of *Drosera* species in the state of Espírito Santo. ● = *Drosera intermedia*; ▲ = *Drosera latifolia*.

emergences present on the adaxial lamina surface, or lamina modified into a bilobed snap trap with sensitive trichomes over the adaxial surface. Inflorescence cymose, multi-flowered (rarely uniflorous). Flowers 5-merous (rarely 4-merous), actinomorphic; stamens 5(–many), anthers longitudinally dehiscent; ovary superior, 3–5-carpellar; styles 1–5 (usually 3), usually bifurcated at the base (rarely entire); ovary with parietal placentation (rarely basal), pluriovulated. Fruit a loculicidal capsule; seeds numerous.

***Drosera*** L. (description based solely on the species occurring in Espírito Santo).

Terrestrial or rupicolous herbs. Leaves rosetted or spirally arranged, stipulate, petiolate, red to green in color, with sessile glands; stipules intrapetiolar, membranaceous, with apex lacinate; petiole linear, glabrous or eglandular-pilose at least abaxially; lamina oblong, lanceolate or spatulate, with vascularized glandular emergences (tentacles) on the adaxial surface, abaxial surface glabrous or

eglandular-pilose. Inflorescence a scorpioid cyme, multiflorous (rarely uniflorous), 1–few per plant, with sessile glands; scape glabrous or eglandular and glandular-pilose. Flowers ephemeral, anthesis lasting for a few hours; sepals fused at the base, glabrous or glandular-pilose; petals white or pink; stamens 5; ovary 1-locular; styles bifurcated at the base. Petals, sepals and stamens persistent in fruit. Seeds with papillose or reticulate testa.

*Drosera* is the largest genus in the family, comprising about 250 species distributed worldwide and concentrated in the Southern Hemisphere. The main center of diversity of the genus is in the southwest of Western Australia, followed by northern Australia, the Cape Province of South Africa, and the mountains of east-central Brazil (Fleischmann *et al.* 2018). The genus is immediately identified by the presence of glandular emergences (tentacles) over the adaxial leaf lamina surface (Figs. 2-4). In Espírito Santo, *Drosera* is represented by two species, which are described below.

#### Identification key to the species of *Drosera* from the Espírito Santo state

1. Leaves, scape and sepals glabrous. Lamina 5.2–8.1 mm long, spatulate. Sepals 3–3.5 mm long; petals white. Seeds ovoid, testa surface papillose ..... 1. *Drosera intermedia*
- 1'. Leaves eglandular-pilose, at least on the abaxial surface, scape and sepals glandular and eglandular-pilose. Lamina 8.4–9.75 mm long, lanceolate to oblong. Sepals 5–5.5 mm long; petals pink. Seeds fusiform, testa surface reticulate ..... 2. *Drosera latifolia*

**1. *Drosera intermedia*** Hayne in Dreves & Hayne, Bot. Bilderb. 3: 18, t. 3B. 1798. Figs. 1; 2a-d; 3

Perennial rosetted herb. Subglabrous indumentum consisting solely of minute sessile glands, red in color (black in dry specimens), on both leaf surfaces, scapes and sepals abaxially. Leaves persistent when old, reddish; petiole 15–30 mm long; lamina 5.2–8.1 mm long, spatulate, apex rounded, adaxial surface covered with numerous red, carnivorous, capitate tentacles, 0.1–3.4 mm long, and minute sessile glands, abaxial surface covered with minute sessile glands; stipules 2.6–4.1 mm long, rectangular, membranaceous, the apical divided into several lacinate segments. Scapes 2–4 per plant, 9–14 cm long (including floriferous part), flattened, base curved, green to red in color; inflorescence a scorpioid cyme, bearing 6–10 flowers; sepals 5, 3–3.5 mm long, lanceolate, minute sessile glands, apex acute; petals 5, 4.5–5 mm long, whitish; stamens 5,

3.5–4 mm long, anthers 0.53–0.74 mm long; ovary 3-carpellate, fused, ca. 2.5 mm long, globose, 3-lobed in outline; styles 3, forked at the base; fruit a dry dehiscent capsule, ca. 6 mm long, globose, 3-valvate; seeds ovoid, 0.4–0.82 mm long, testa papillose.

**Specimens examined:** Conceição da Barra, Parque Estadual de Itaúnas, 18.5932°S, 39.7322°W, 24.VIII.2002, O.J. Pereira *et al.* 6997 (VIES). Guarapari, Parque Estadual Paulo César Vinha, 20.5994°S, 40.4108°W, 6.VIII.2020, J.C. Guarnier *et al.* 467 (VIES); 18.VIII.2020, fl. and fr., S.V. Caram *et al.* 01 (VIES). Vitória, área da C.V.R.D., 20.3194°S, 40.3377°W, 15.VIII.2007, fl., O.J. Pereira & G. Lübe 7517 (VIES). Vila Velha, PEPCN, 20.3297°S, 40.2924°W, 29.IX.2007, fl., R.T. Valadares *et al.* 578 (HURB).

*Drosera intermedia* has a wide distribution, occurring in central and western Europe, Asia Minor, East Africa, and North, Central, and South America, including Brazil (Fleischmann & Gonella 2020; Gonella 2020). The species was

recently recorded in Espírito Santo for the first time (Valadares *et al.* 2020), expanding its known distribution in Brazil, where it has also been recorded in the states of Rio de Janeiro, Bahia, Amapá, and Roraima (Gonella 2020). In Espírito Santo, the species occurs in the *restingas* (Fig. 1), in areas of herbaceous marshland. It has been found in the protected areas of the Parque Estadual Paulo César Vinha (PEPCV) and the Parque Estadual de Itaúnas. In the wet areas of the PEPCV, which are

a structurally dynamic environment, *D. intermedia* is always found associated with flat and stabilized sedimentary zones (humid fields), protected from natural and dynamic drainage channels that constantly modify the structure of the vegetation (Valadares *et al.* 2020). It was collected in flower in August and September and with fruits in August.

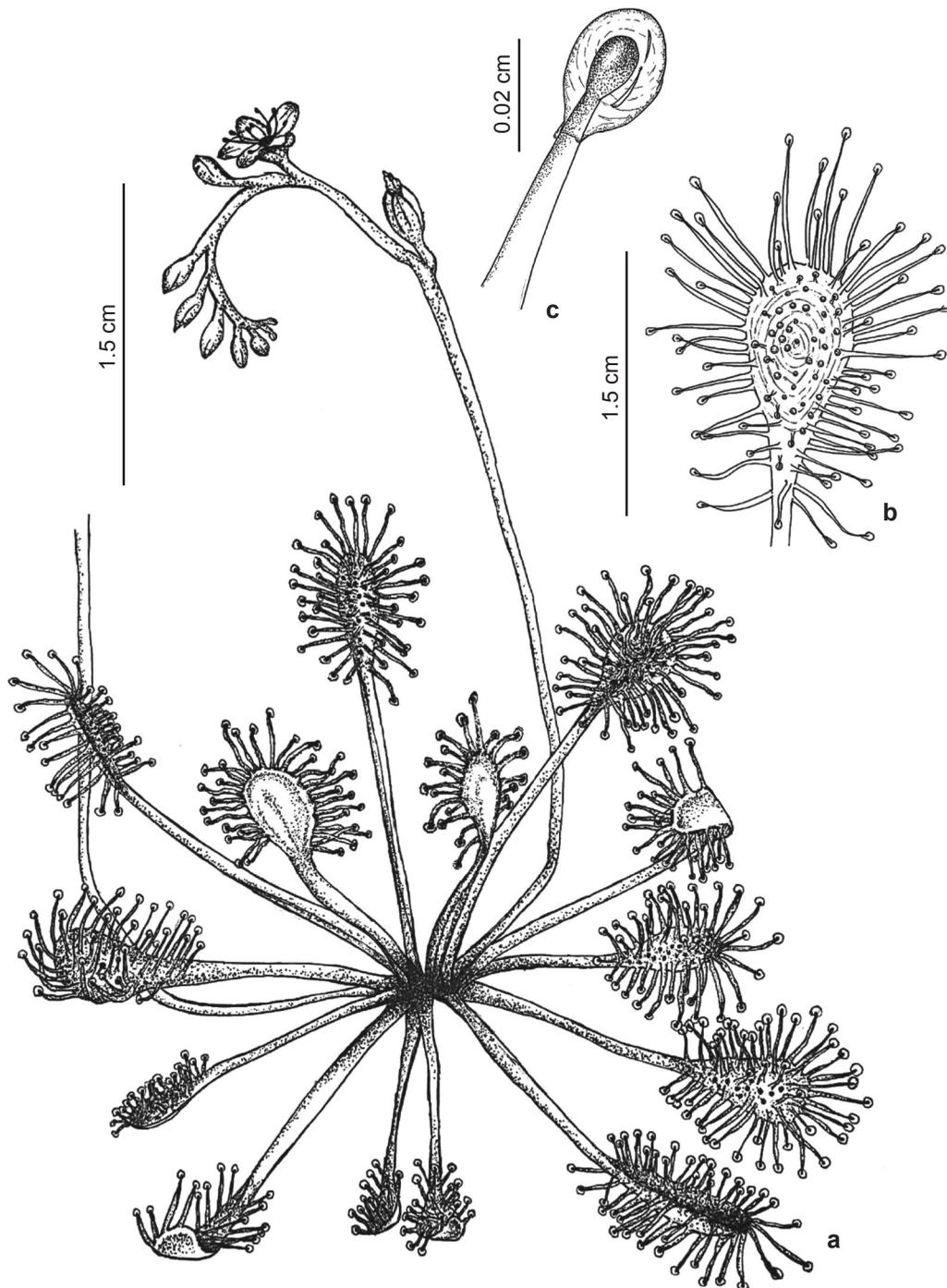
The species is characterized by glabrous leaves (only presenting sessile glands; Fig. 3), spatulate (Figs. 2b; 3b), with a petiole narrower and



**Figure 2** – a-d. *Drosera intermedia* – a. habit; b. detail of the leaf; c. flower; d. fruits (all photos taken at PEPCV). e-f. *Drosera latifolia* – e. habit; f. detail of the leaf (all photos taken at PN Caparaó). (a-d. by VF Dutra; e. by HL Silva; f. by AV Scatigna).

at least three times longer than the lamina (Figs. 2b; 3a), stipules fimbriate from the base, inflorescence and sepals glabrous, white petals (Fig. 2c), and ovoid seeds with a papillose testa.

*Drosera intermedia* was not assessed for the Espírito Santo Red List (Fraga *et al.* 2019) as no records had been identified in the state at the time of its elaboration. While the species is globally



**Figure 3** – a-c. *Drosera intermedia* – a. habit; b. leaf lamina, adaxial surface; c. tentacle head. (All based on *Caram et al. 01*).

classified as Least Concern (Cross *et al.* 2020), its occurrence in the state is restricted to an AOO of 16 km<sup>2</sup> (criterion B2; IUCN 2012a). In addition, it is limited to fewer than five known locations (sub-criterion B2a), and its habitat is in a state of continuous decline (sub-criterion B2biii) since the state's coast is considered to be under high anthropic pressure due to pollution, fires, and urban expansion over the *restingas* (Maciel 1990; MMA 2002; Fraga *et al.* 2019). Therefore, we assess the species as Endangered (EN) in Espírito Santo.

**2. *Drosera latifolia*** (Eichler) Gonella & Rivadavia, Phytotaxa 156: 21. 2014. Figs. 1; 2e-f; 4

Perennial rosetted herb. Indumentum consisting of white eglandular trichomes (brown in dry specimens), present on the abaxial leaf surface and petiole; glandular capitate trichomes - the stalk light red and translucent, the head dark red - present on scapes and sepals abaxially; minute sessile glands red in color (black in dry specimens), on both leaf surfaces, scapes, pedicels, bracts and sepals abaxially. Leaves persistent, green to red; petiole 4.6–5.3(–10) mm long; lamina 8.4–9.75(–25) mm long, lanceolate to oblong, apex rounded, adaxial surface covered with numerous red, carnivorous, capitate tentacles, 2.28–3.54 mm long, and minute sessile glands, abaxial surface with eglandular trichomes, and minute sessile glands; stipules 2.48–3.51 mm long, square, membranaceous, the apical divided into several lacinate segments. Scapes 1–3 per plant, 9–18(–34.7) cm long (including floriferous part), cylindrical, base erect, green in color; inflorescence a scorpioid cyme, often bifurcating, bearing 2–9(–27) flowers; sepals 5, 5–5.5 mm long, lanceolate, with glandular capitate trichomes, and few eglandular trichomes, apex acute or obtuse; petals 5, 7–7.5 mm long, pink; stamens 5, 2.5–3.5 mm long, anthers ca. 1 mm long; ovary 3-carpellate, fused, 2–3 mm in diam., globose, 3-lobed in outline; styles 3, forked at the base; fruit a dry dehiscent capsule, ca. 3 mm long, globose, 3-valvate; seeds fusiform, ca. 0.8 mm long, testa reticulate.

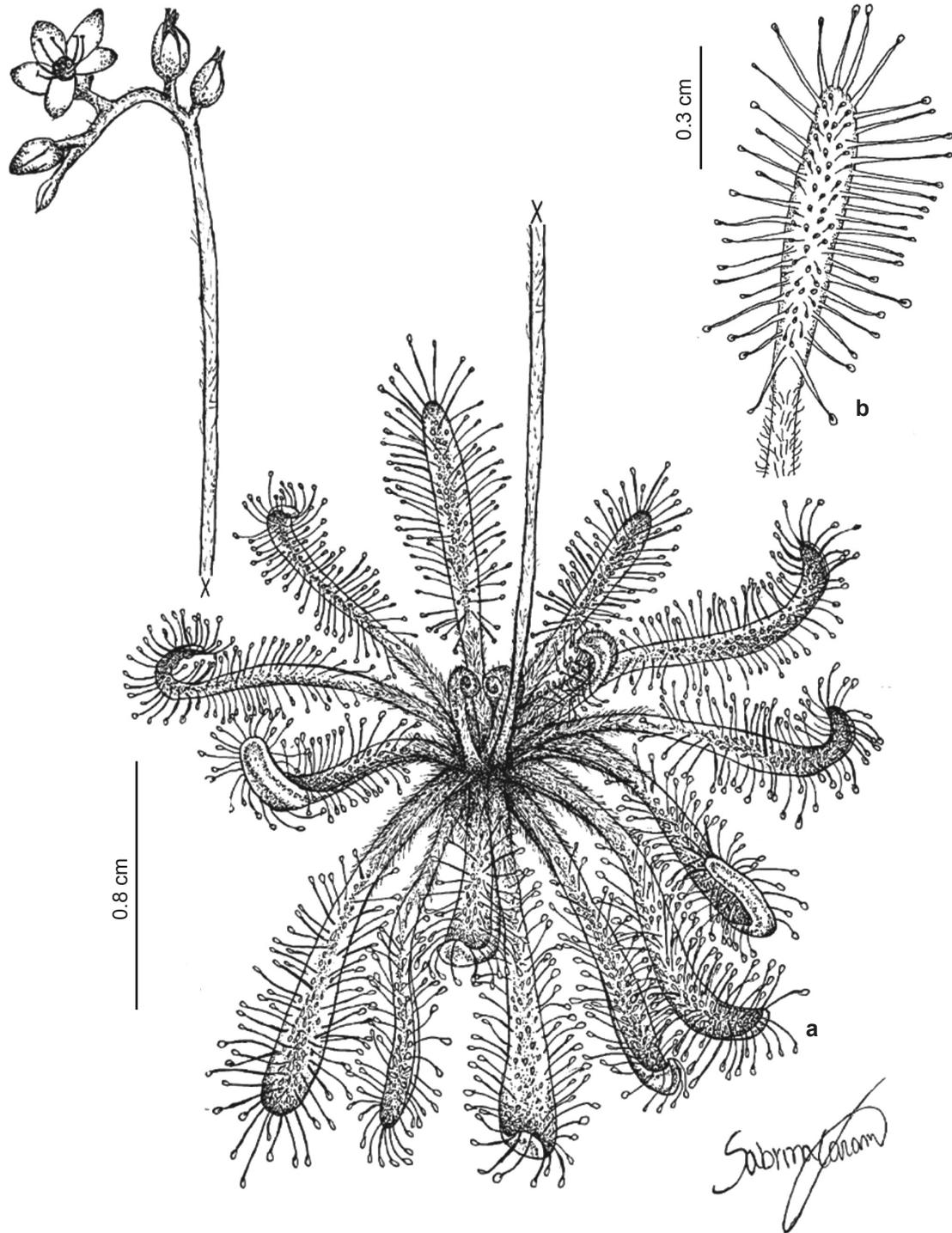
**Specimens examined:** Alegre, Serra Caparaó, Pico da Bandeira, 20.4340°S, 41.7966°W, 3.III.1959, fl., *H.S. Irwin 2804* (NY, US). Castelo, Forno Grande, 8.XII.1948, *A.C. Brade 19249* (RB). Domingos Martins, topo da Pedra Azul, 19.XI.1975, *Kautsky 517* (HB). Ibitirama, Parque Nacional do Caparaó, entre o Acampamento Macieira e o Pico da Bandeira, 18.I.2019, fl., *H.L. Silva & L.J. Lieven 257* (VIES). São Roque do Canaã, Alto Misterioso, 19.7969°S, 40.7752°W, 11.V.2007, fr., *C.*

*Esgario et al. 171* (MBML); 19.7972°S, 40.7750°W, 15.XI.2004, fl., *A.P. Fontana et al. 1072* (MBML). Serra da Caparaó, 25.XI.1929, fl., *Y. Mexia 40251* (GH, MO).

*Drosera latifolia* is endemic to Brazil, occurring in the mountain ranges of Serra do Mar, Serra da Mantiqueira, and the Espinhaço Range in the states of Santa Catarina, Paraná, São Paulo, Minas Gerais, Rio de Janeiro, and Espírito Santo (Gonella *et al.* 2014). In Espírito Santo, the species is rupicolous (Fig. 2e), occurring in areas of ecological refuges and ombrophilous forests (Fig. 1). It is found on the summits of the state's larger granitic inselbergs, which are considered to be a transition between the sugar loaf inselbergs and *campos de altitude* (montane grasslands) by de Paula *et al.* (2020), such as in the Parque Estadual da Pedra Azul, Parque Estadual do Forno Grande, and Alto Misterioso, and the *campos de altitude* of the Parque Nacional do Caparaó. According to Gonella *et al.* (2014), the individuals collected at Caparaó represent the smallest sized morphotype of *D. latifolia*, as well as the one that occurs at the highest elevation (up to 2,550 m). The remaining populations in the state represent the typical morphotype described by Gonella *et al.* (2014). The species was previously recorded in the floristic inventory of Alto Misterioso (Esgario *et al.* 2009) and Parque Nacional do Caparaó (Moreira *et al.* 2020) as *D. villosa*. *Drosera latifolia* was recorded with flowers in January, March, and November and with fruits in May.

The species is characterized by its lanceolate to oblong leaves (Figs. 2f; 4), a petiole shorter than or equaling the lamina, eglandular trichomes present on the abaxial leaf surface and eventually on the adaxial petiole surface, glandular-pilose inflorescence and sepals, pink petals, and fusiform seeds with reticulate testa.

*Drosera latifolia* is listed as Data Deficient in the Espírito Santo Red List (Fraga *et al.* 2019) and globally assessed as Least Concern (Cross *et al.* 2020). The new information on its distribution in the state presented here allows its regional assessment to be updated to Near Threatened (NT) in the state of Espírito Santo. While the species has an AOO of 16 km<sup>2</sup> (criterion B2) and a naturally fragmented distribution due to its occurrence in mountaintops, with fewer than five locations (sub-criterion B2a), no continuing decline has been observed to affect the subpopulations (sub-criterion B2b). Three of the four known locations in the state are found within protected areas, except for the Alto Misterioso, a priority conservation area (Esgario *et al.* 2009).



**Figure 4** – a-b. *Drosera latifolia* – a. habit; b. leaf, adaxial surface. (All based on Irwin 2804).

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