Cactaceae from Reserva Biológica do Alto da Serra de Paranapiacaba, Santo André, São Paulo State, Brazil

Zedenil Rodrigues Mendes¹,³ and Renata Sebastiani¹,²

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Introduction

Cactaceae is a neotropical family with 124 genera and 1,438 species easily recognized by its spiny stems, with long differentiated shoots producing photosynthetic leaves and short shoots (areoles) with a spine or spine cluster (Hunt et al. 2006, Zappi et al. 2007, Calvente 2010). About 10% of Cactaceae species are epiphytes adapted to more humid regions, distributed from Mexico to Argentina and the centers of diversity of the family are Mexico, Brazil east coast and the Andes (Hunt et al. 2006, Zappi et al. 2007, Calvente 2010). According to Zappi et al. (2010), there are 233 species of Cactaceae in Brazil, distributed in 37 genera. Species of *Rhipsalis* may be found in African and Asian continents (Zappi et al. 2007, Calvente 2010).

Brazilian east coast rainforests hold almost 30% of Cactaceae species, with 74% of them endemic to the Atlantic Forest, one of the most threatened tropical rainforests in the world (Myers et al. 2000, Calvente 2010). Its vegetation consists of ombrophilous, dense and evergreen tropical rainforest, currently reduced to only 7.5% of its original size, with forest remnants distributed along disconnected areas, with only 35.9% legally protected (Myers et al. 2000, Coutinho 2009).

There are 13 genera and 43 species of Cactaceae in Atlantic Forest of São Paulo State, being *Rhipsalis* the most diverse genera with 22 species (Zappi et al. 2007). In a survey conducted in Rio de Janeiro...
State, Calvente et al. (2005) showed the occurrence of 45 species, the genus *Rhipsalis* being the most representative, with 23 species. Lombardi (1991) also conducted a survey in São Paulo State and described 16 species of *Rhipsalis* with cylindrical cladodes. Lately, Lombardi (1995) repeated it for the *Rhipsalis* with flattened cladodes describing six species. In the metropolitan region of São Paulo City there are important remnants of Atlantic Forest as Reserva Biológica do Alto da Serra de Paranapiacaba (Santo André), Reserva Floestal do Morro Grande (Cotia) and Reserva do Curucutu (São Paulo).

Reserva Biológica do Alto da Serra de Paranapiacaba (PBR) is located at Paranapiacaba district, near the Industrial Center of Cubatão, which is one of the most polluted industrial hub in the world, and has conspicuously influenced PBR’s vegetation with air pollution in the past.


A compelling argument in favor of cactus conservation is their economic potential, if used sustainably, both at the local level and for international trade (Taylor & Zappi 2004). Cactaceae species are highly appreciated as ornamental plants, and attracts numerous collectors throughout the world, decreasing some natural cacti populations. These and other human influences as pollution caused the decline of cacti endemic species habitats, making the studies on the taxonomy and evolutionary biology an emergent priority in this group (Calvente 2010). A floristic study on Cactaceae species from PBR seems reasonable, since its real diversity is not known. Zappi et al. (2007), for instance, cite several species of Cactaceae to the Atlantic Forest of São Paulo that are not listed to PBR’s checklist. Besides, the occurrence of certain species may help to understand the influence of air pollution in this area, since epiphytic species of Cactaceae are efficient indicators of atmospheric pollution, due to absorption of chemical elements from the atmosphere (Elias et al. 2006).

Thus, the goal of this study was to conduct a floristic study of Cactaceae species from Reserva Biológica do Alto da Serra de Paranapiacaba, including its geographical boundaries in Vale da Fumaça and Vale do Rio Mogi.

**Material and methods**

The District of Paranapiacaba belongs to the municipality of Santo André (São Paulo Metropolitan Region) and currently comprises three legally protected areas: Reserva Biológica do Alto da Serra de Paranapiacaba (PBR), with restricted access, Parque Natural de Paranapiacaba, under the responsibility of Santo André City, and a portion of Parque Estadual da Serra do Mar, under the responsibility of Instituto Florestal. As stated by the Brazilian System of Conservation Units (Ministério do Meio Ambiente 2006), a Biological Reserve is a protected area of restricted access, aiming the biological conservation and scientific research. Reserva Biológica do Alto da Serra de Paranapiacaba was created in 1909, belongs to Instituto de Botânica and function as a biological laboratory to study plants and animals and for environmental education (Lopes et al. 2009). The main limits of PBR are SP-122 highway, part of the trail of Vale do Rio Mogi and part of the trail of Vale da Fumaça. These regions have well preserved forests which boards PBR's area and general information about biotic and abiotic factors can be found in Lopes et al. (2009a).

Specimens were collected from August 2008 to August 2009. Plants were collected in areas near the main trails of PBR as well as the bordering trails in Vale da Fumaça and Vale do Rio Mogi. All specimens were deposited in UNIP Herbarium. Paranapiacaba Biological Reserve Phanerogamic Flora housed at SP and SPF herbaria were also analyzed. In case of available material from the studied area deposited in the SP herbarium lacked flowers or fruits additional collections for *Lepismium houlletianum* (Lem.) Barthlott, *Rhipsalis baccifera* subsp. *shaferi* (Britton & Rose) Barthlott & N. P. Taylor, *R. burchelli* Britton & Rose, *R. campos-portoana* Loefgr., *R. floccosa* Salm-Dyck ex Pfeiff., *R. juengeneri* Barthlott & N.P. Taylor, *R. olivifera* N.P. Taylor & Zappi, *R. paradoxa* (Salm-Dick ex Pfeiff.) Salm-Dick,
R. pulchra Loefgr. and R. puniceodiscus G. Lindb. were analyzed. Number of seeds per fruit were described. However the collections of Rhipsalis paradoxa (Salm-Dick ex Pfeiff.) Salm-Dick had no fertile material available for counting seeds. The collections of Rhipsalis neves-armondii K. Schum. also did not have a minimum number of fruits for analysis. Therefore, the fruits were not taken aiming to preserve the collections. Calvente et al. (2005) indicates the importance of recording characteristics such as color of flowers and fruits in the collections as they are lost after herborization.

Results and Discussion

Key to Cactaceae from Reserva Biológica do Alto da Serra de Paranapiacaba

1. Plants basicaulous or caulous (never acrocaulous); cladodes partially flattened with cylindrical and ligneous base ........................................................................................................................ 2. L. houlletianum
   1. Plants acrocaulous or subacrocaulous (except basal cladodes); cladodes totally cylindrical, totally flattened or clavated
   2. Cladodes with clavated apex; plants acrocaulous .......................................................... 1. H. salicornioides
   2. Cladodes cylindrical or flattened; plants acrocaulous or subacrocaulous
      3. Cladodes flattened
         4. Cladodes 2-4-branched; ripe fruits pink .................................................................. 6. R. elliptica
         4. Cladodes 2-branched; ripe fruits light green .......................................................... 10. R. olivifera
      3. Cladodes cylindrical
         5. Cladodes ribbed and winged .................................................................................. 11. R. paradoxa
         5. Cladodes smooth, unribbed and unwinged
            6. Pericarpel immersed
               7. Fruits intense yellow; perianth segments ca. 11; stamens ca. 38 .................. 13. R. puniceodiscus
               7. Fruits white, deep pink or slightly purplish; perianth segments 7-8; stamens 68-82
                  8. Cladodes 3-6 mm diameter, pendulous; flowers saucer shaped .................. 7. R. floccosa
                  8. Cladodes up to 3 mm diameter, suberect; flowers campanulate .............. 9. R. neves-armondii
               6. Pericarpel emerged
                  9. Flowers campanulate; perianth segments 8-12
                     10. Stamens with orange base; cladodes 17-35 cm long ............................. 12. R. pulchra
                     10. Stamens without orange base; cladodes 2-5.5 cm long
                        11. Stamens white with pinkish base; fruit orange .......................... 5. R. campos-portoana
                        11. Stamens white; fruit translucent with reddish apex ........................ 4. R. burchellii
                     9. Flowers saucer shaped; perianth segments 5-8
                        12. Stamens with yellowish base; pericarpel tubular .............................. 8. R. juengeri
                        12. Stamens without yellowish base; pericarpel hemispheric, subglobose or obovoid
                           13. Cladodes 5.3-8.7 cm long, up to 2 mm diameter ................................. 14. R. teres
                           13. Cladodes 9-16 cm long, 3-5 mm diameter ......................................... 3. R. baccifera subsp. shaferi

Epiphytes or lithophytes. Cladodes acrocaulous, 2-8-branched; apex clavated, 1.5-2.5 cm long, base with ca. 1 mm and apex with 1-3 mm diameter. Young cladodes spiny. Flower terminal, 0.7-1.1 cm diameter, 1 per areole, semitubular; perianth segments 15, the external 5-6 x 3 mm, triangular, intense yellow with orange apex, the internal 8-10 x 1.5-2 mm, lanceolate, yellow; pericarpel ca. 3 x 3 mm, hemispheric, green, emerged; ca. 53 stamens, ca. 6 mm long, white, included; style white, ca. 9 mm long, inserted, stigma 4-lobed, lobes ca. 1 mm long. Fruit deep pink, globose, 1 per cladode, 4-5 x 4-6 mm. Seeds dark brown to black, 0.5-1 x 1 mm, 9-27 per fruit.

Phenology and habitat: Flowers were collected in August and September and fruits in March. It shows a wide distribution in southeastern and southern Brazil, in the Atlantic Forest and in the Semi-deciduous Forests, from Bahia to Paraná (Zappi et al. 2007, 2010).
This species is easily found as lithophytic near rivers in sites with high luminosity. It can be characterized by the presence of brownish cladodes, a character not previously reported for this species in São Paulo. However, Zappi & Taylor (1990) described this species for the Flora of Serra do Cipó (Minas Gerais) with thick basal segments and brownish bark. When it is lithophytic, it shows a cylindrical, ligneous and erect extensive cladode up to 30 cm long and 3-5 mm diameter. When epiphytic, it shows evergreen cladodes. This species presents rather diverse morphology, partly related to growth conditions (Zappi & Taylor 1990), with globular and vinaceous cladodes when exposed to sunlight and with clavated and green cladodes when growing in the shade.


Epiphytes. Cladodes basicaulous or caulious, partially flattened with cylindrical and ligneous base; flattened part serrate; 13-30 × 1.7-5.5 cm, ca. 1.5 mm diameter; suberect. Flower developing on the surface of branches, one flower per areole, 1-1.8 cm diameter; pericarpel 2 × 4 mm, angled, pink, emerged; perianth segments 9-10, erect or suberect, white or slightly pink; stamens ca. 20, 7-11 mm long, included, segments 9-10, erect or suberect, white or slightly yellowish; pericarpel 3-4 × 1.5-2 mm, lanceolate to linear, white to slightly yellowish; style ca. 0.5 × 1 mm, 27-29 per fruit. Phenology and habitat: Flowers were collected in May and June and fruits were collected in August. This species occurs in the Atlantic Forest of Minas Gerais, Espírito Santo, Rio de Janeiro, São Paulo, Paraná, and Santa Catarina (Zappi et al. 2007, 2010).


*Lepismium* differs from the other genera by its branching pattern. While *Hattoria* and *Rhipsalis* show an acrocaulous or subacrocaulous branching (except basal cladodes), *Lepismium* shows only basicaulous or caulious branching, never acrocaulous. *Lepismium houlletianum* has cladodes with a cylindrical basal portion and the distal part flattened. The faded cladodes remain attached to the plant. Calvente (2005) considered this species as near threatened and characteristic of preserved places.


Epiphytes or lithophytes. Cladodes acrocaulous or subacrocaulous, 2-5-branched, cylindrical, 9-16 cm long, 3-5 mm diameter, pendulous. Flower lateral to subterminal, saucer shaped, 1-2 flowers per areole, 0.5-0.7 cm diameter; perianth segments 5-7, patent, the external ca. 2 × 1 mm, triangular, greenish to brownish, the internal 3-4 × 1.5-2 mm, lanceolate to linear, white to slightly yellowish; pericarpel 2-3 × 2 mm, subglobose to obovoid, green, smooth, emerged; stamens 20-25, 2-3 mm long, white, same height of style; style 2-3 mm long, white, stigma 2-3-lobed, lobes ca. 0.5 mm long. Fruit white or light pink, globose, 1 per cladode, 6-8 × 6-10 mm. Seeds dark brown to black, ca. 0.5 × 1 mm, 10-31 per fruit.

Phenology and habitat: Fruits were collected in March and May. This species occurs in Paraguay, southeast Bolivia, northeast Argentina and Brazil (São Paulo State), with its distribution extending to Asia and Africa (Zappi et al. 2007, Calvente 2010).


*R. baccifera* can be confused with *R. teres* by the habit. However, according to Zappi et al. (2007), *R. baccifera* shows the pericarpel more developed...
than the perianth segments, unlikely *R. teres*. There are three subspecies of *R. baccifera*: *R. baccifera* subsp. *bacicifera*, widely distributed in brazilian territory; *R. baccifera* subsp. *hileiabaiana* N.P. Taylor & Barthlott, endemic to Cerrado areas in Bahia State; and *R. baccifera* subsp. *shaferi* (Britton & Rose) Barthlott & N.P. Taylor, common in the Cerrado and in the Atlantic Forest regions of southeast Brazil. Only *R. baccifera* subsp. *shaferi* is found in Paranapiacaba Biological Reserve.


Epiphytes. Cladodes acrocaulous or subacrocaulous, 2-5-branched, cylindrical, 3.9-5.5 cm long, 1-1.5 mm diameter, pendulous. Flower terminal or subterminal, campanulate, 1-2 per areole, 1.2-1.7 cm diameter; perianth segments 9-11, the external ca. 6 × 4 mm, ovate, white, the internal ca. 11 × 3 mm, lanceolate, white; pericarpel ca. 3 × 2 mm, globose, greenish, emerged; stamens 20-30, ca. 7 mm long, white, included; style white, 7-8 mm long, included, stigma 3-lobed, lobes ca. 3 mm. Fruit translucent with reddish apex, globose, 1 per cladode, ca. 6 × 7 mm. Seeds dark brown, ca. 0.5 × 1 mm, 6-19 per fruit.

Phenology and habitat: Flowers and fruits were collected in March. This species occurs in the Atlantic Forest and in Altitudinal Forests from Minas Gerais, Rio de Janeiro, São Paulo, Paraná and Santa Catarina (Zappi et al. 2007).

Specimens examined: BRASIL. SÃO PAULO. Santo André, Distrito de Paranapiacaba, Paranapiacaba Biological Reserve, 30-IX-1982, A.C. Maruffa et al. 51 (SP); idem, 26-XI-1980, N.A. Rosa 3239 (SP); idem, 8-X-1947, M. Kuhlmann 2706 (SP); idem, 25-VIII-1987, M. Kirizawa 1906 (SP); idem, 1-XI-1988, M. Kirizawa 2093 (SP); idem, 4-X-1985, T.P. Guerra & M. Kirizawa 132 (SP); idem, 27-VIII-1980, E. Forero et al. 7628 (SP); idem, 25-IX-1992, G.T. Gonçalves s.n. (SP256045).

Adicional specimens examined: BRASIL. SÃO PAULO: Barra do Turvo, 14-II-1995, J.P. Souza et al. 64 (SP).

These collections were initially treated as *R. burchelli*, probably by the great similarity between the species.


Epiphytes. Cladodes acrocaulous or subacrocaulous, 2-4-branched, cylindrical, 2-4 cm long, 1.5-2 mm diameter, pendulous. Flower terminal or subterminal, campanulate, 1-2 per areole, 1.2-1.7 cm diameter; perianth segments 9-12, the external ca. 3 × 5 mm, ovate, white, the internal ca. 11 × 2.5 mm, lanceolate, white; pericarpel ca. 3 × 2 mm, globose, greenish, emerged; stamens 20-35, up to 7 mm long, white with pink base, included; styles white, 7-8 mm long, included, stigma 3-lobed, lobes ca. 3 mm. Fruit orange, globose, 1 per cladode, ca. 5-6 × 6.5-7 mm. Seeds dark brown, ca. 0.5 × 1.5 mm, 2-6 per fruit.

Phenology and habitat: Flowers and fruits were collected from August to November. This species occurs in the Atlantic Forest and in Altitudinal Forests from Minas Gerais, Rio de Janeiro, São Paulo, Paraná and Santa Catarina (Zappi et al. 2007).

Specimens examined: BRASIL. SÃO PAULO: Santo André, Distrito de Paranapiacaba, Paranapiacaba Biological Reserve, 30-IX-1982, A.C. Maruffa et al. 51 (SP); idem, 26-XI-1980, N.A. Rosa 3239 (SP); idem, 8-X-1947, M. Kuhlmann 2706 (SP); idem, 25-VIII-1987, M. Kirizawa 1906 (SP); idem, 1-XI-1988, M. Kirizawa 2093 (SP); idem, 4-X-1985, T.P. Guerra & M. Kirizawa 132 (SP); idem, 27-VIII-1980, E. Forero et al. 7628 (SP); idem, 25-IX-1992, G.T. Gonçalves s.n. (SP256045).

Adicional specimens examined: BRASIL. SÃO PAULO: Barra do Turvo, 14-II-1995, J.P. Souza et al. 64 (SP).

These collections were initially treated as *R. burchelli*, probably by the great similarity between the species.


Epiphytes or lithophytes. Cladodes acrocaulous, 2-4-branched, flattened, margin wavy, 5-14 cm long, 2.2-5.5 cm large, 1-2 mm thick, pendulous. Flower lateral or subterminal, saucer shaped, 1-2 per areole, 1.2-1.8 cm diameter; perianth segments 8, the external ca. 4.4-5.5 × 2-3 mm, triangular, yellow, the internal ca. 6-7 × 2-3 mm, lanceolate, white to yellow; pericarpel 3-4 × 3.5-5 mm, tubular, greenish-yellow, emerged; stamens 73-83, up to 1.1 cm long, white, exserted; styles white, 5-7 mm long, exserted, stigma
3-4-lobed, lobes ca. 3 mm long. Fruit pink when ripe, tubular, 2 per cladode, 5 × 7-8 mm. Seeds black, ca. 0.5 × 1 mm, 4-16 per fruit.

Phenology and habitat: Flowers were collected in May and fruits in March. This species is common in eastern Brazil, occurring from Minas Gerais to Rio Grande do Sul in the Atlantic Forest, Restinga vegetation and Semidecidual Forest (Zappi et al. 2007, 2010).


This species is widely distributed throughout Fumaça Valley and have epiphytic and lithophytic habits. The flowers have a pleasant and mild aroma. *R. elliptica* shows totally pink fruits, while *R. olivifera* shows green fruits sometimes with a pink border around the apex.

The number of stamens of specimens from PBR, was higher than reported by Zappi et al. (2007). According to Calvente (2010), *R. elliptica* has two subspecies, *R. elliptica* subsp. *elliptica* and *R. elliptica* subsp. *microflora* Calvente, that differ in the dimension of floral structures, but both occur in the Atlantic Forest. Probably the typical subspecies *elliptica* occurs in Paranapiacaba, because *R. elliptica* subsp. *microflora* Calvente, that differ in the Pampa State. According to Calvente (2010), *Rhipsalis elliptica* subsp. *elliptica* is distinct from *R. elliptica* subsp. *microflora* by the larger flowers. This specimens studied presented the flowers 12-18 mm in diameter, 73-83 stamens and pink fruits. These characteristics are similar to those of *R. elliptica* subsp. *elliptica* described by Calvente (2010), with flowers 11-14 mm diam., stamens 60-100 and deep magenta to white fruit.


Epiphytes or lithophytes. Cladodes acrocaulous, 2-8-branched, cylindrical, 8.5-22 cm long, 3-6 mm diameter, basal cladode extended up to 34 cm from the phorophyte, pendulous. Flower lateral, saucer shaped, 1 per areole, 0.7-0.9 cm diameter; perianth segments 7, the external 2-3 × 3-3.5 mm, triangular, yellowish, the internal 1.5 × 4.5-5 mm, lanceolate, yellowish; pericarpel 1.5 × 2 mm, hemispheric, immersed; stamens 82, 2.5-3 mm long, yellowish-white, exserted; styles yellowish-white, up to 3.5 mm long, exserted, stigma 3-lobed, lobes ca. 1 mm long. Fruit white or slightly purplish-pink, globose, 1-9 per cladode, 4-6 × 5-7 mm. Seeds black to dark brown, ca. 0.5 × 1 mm, 2-14 per fruit.

Phenology and habitat: Flowers and fruits were collected in March and May. It is a relatively abundant species, occurring in montane and riparian forests, also in forest clumps. It occurs in Venezuela, Peru, Bolivia, Argentina, Paraguay and Brazil (Pernambuco, Sergipe, Bahia, Minas Gerais, Espirito Santo, Rio de Janeiro, São Paulo, Paraná, Santa Catarina and Rio Grande do Sul) (Zappi et al. 2007).


According to Zappi et al. (2010) there are three subspecies of *R. floccosa*: *R. floccosa* subsp. *floccosa*, common in parts of northeast and southeast of Brazil; *R. floccosa* subsp. *oerophila* N.P. Taylor & Zappi, found in Cerrado and Caatinga areas from Bahia and Minas Gerais States; and *R. floccosa* subsp. *pulvinigera* (G. Lindb.) Barthlott & N.P. Taylor, which occurs in Cerrado and Atlantic Forest areas in southeastern and southern Brazil. For measuring the flowers, dried material was used, but the color view can be altered. In Bauer & Waechter (2006), Lombardi (1991) and Zappi et al. (2007), the perianth segments have reddish apex and can vary from white to greenish yellow. However, the color of pericarpel is not described. The stamens have been described as white in Bruxel & Jasper (2005) and Zappi et al. (2007) and yellowish in Bauer & Waechter (2006). Only Bauer & Waechter (2006) described the color of the style as greenish-white.


Epiphytes. Cladodes acrocaulous, 2-6-branched, cylindrical, 4.8-7.5 cm long, 1.5-3.5 mm diameter,
basal cladode extended up to 18 cm from the phorophyte, pendulous. Flower subterminal, saucer shaped, 1-3 per areola, 4 × 6 mm diameter; perianth segments 5, the external ca. 2 × 2 mm, ovate, yellowish green, the internal ca. 4 × 2 mm, lanceolate, yellowish-green; pericarpel 1.5 × 2 mm, tubular, light green, emerged; stamens ca. 20, ca. 3 mm long, white with yellowish base, exerted; style white, 4 mm long, exerted, stigma 3-lobed, lobes ca. 1 mm long. Fruit globose, 1-2 per cladode, 4-5 × 4-5 mm. Seeds black, ca. 0.5 × 1 mm, 8-13 per fruit.

Phenology and habitat: Flowers were collected in January. This is a rare species, occurring in highland forests from Minas Gerais and in the Atlantic Forest and hillside forests from São Paulo (Zappi et al. 2007).


Adicional specimens examined: BRASIL. MINAS GERAIS: Conceição de Ibitipoca, PE de Ibitipoca, 13-1-2007, A.M. Calvente 266 (SPF); idem, 11-III-2004, R.C. Forzza 3204 (SPF).

The number of stamens and perianth segments observed differ from those reported by Zappi et al. (2007). In our study, ca. 68 stamens and ca. 8 perianth segments were counted, while Zappi et al. (2007) pointed 11-13 stamens and 35-50 perianth segments. This is a rare species with the flowering areoles being extremely dispersed throughout the cladodes. The collections did not contain sufficient quantity of fruits for counting seeds.

Illustration in Zappi et al. (2007).

Epiphytes. Cladodes acrocaulous or subacrocaulous, 2-6-branched, cylindrical, 6.5-13 cm long, up to 3 mm diameter, suberect. Flower lateral, campanulate, 1 per areole, 1-1.5 cm diameter; perianth segments 8, the external 5 × 4 mm, lanceolate, white with greenish apex, the internal 7 × 3 mm, lanceolate, white; pericarpel ca. 2 × 2.5 mm, setaceous, green yellowish, immersed; stamens ca. 68, up to 5.5 mm long, slightly pinkish-white, inserted; style white, ca. 8 mm long, inserted, stigma 5-lobed, lobes 1-2 mm long. Fruit deep pink, globose, 1 per cladode, ca. 5 × 6 mm. Seeds dark brown, ca. 0.5 × 1 mm, up to 6 per fruit.

Phenology and habitat: Flowers and fruits were collected in January. This species occurs only in Rio de Janeiro, São Paulo and Paraná (Zappi et al. 2007).


The morphological proximity is corroborated by phylogenetic studies. According to Calvente (2010), this species is easily identified by the pale pinkish flowers and large stem segments. The species is poorly described. On a survey of Cactaceae for the state of Rio de Janeiro presented by Calvente et al. (2005) only one specimen (holotype) was examined. Zappi...
et al. (2007) describes the perianth segments cream to green, pericarpel dark green and stamens white.


Epiphytes. Cladodes acrocaulous, 2-branched, cylindrical, 12-67 cm long, the cladodes showing ribs with twisted wings, up to 5 cm long, basal cladodes 7, acrocaulous along the plant, pendulous. Young cladodes spiny. Flower lateral, saucer shaped, 1 per areole, ca. 1.2 cm diameter; pericarpel ca. 3 × 4 mm, rounded, yellow, immersed; perianth segments 10, the external ca. 4 × 5 mm, ovate, yellowish, the internal 5 × 6 mm, elliptical, yellowish; stamens ca. 100, 4-7 mm long, pale yellow, exserted; style ca. 8 mm long, exserted, stigma 5-lobed, lobes 1-2 mm long. Fruit not seen.

Phenology and habitat: Flowers were collected in January. This species occurs in Rio de Janeiro and Santa Catarina in the Atlantic Forest and Semideciduous Forests (Zappi et al. 2007).


Some vegetative characteristics are sufficient to identify this species, as the large cladodes and twisted wings, up to 5 cm. Fruits are not available in the collections analysed. However there is some variations on fruit description in literature. Bauer & Waechter (2006) described the fruits as magenta with 4‑5 mm diameter, Zappi et al. (2007) described the fruits as white with ca. 7 mm diameter and Lombardi (1991) cited only white fruits.


Epiphytes. Cladodes acrocaulous or subacrocaulous, 2-3-branched, cylindrical, 17-35 cm long, 3-4 mm diameter, pendulous. Flower lateral or subterminal, campanulate, 1 per areole, 1-2 cm diameter; perianth segments 11, the external 3 × 6 mm, triangular, white, the internal 8 × 10 mm, lanceolate, white; pericarpel 3 × 3 mm, hemispheric, pinkish, emerged; stamens ca. 67, up to 6 mm long, white with orange base, inserted; style white, ca. 8 mm long, exserted, stigma 4-lobed, lobes ca. 2 mm long. Fruit orange with red apex, globose, 1 per cladode, ca. 8 × 11 mm. Seeds with black colour, ca. 0.5 × 1 mm, 4-22 per fruit.

Phenology and habitat: Flowers and fruits were collected in May. This species occurs in Minas Gerais, Rio de Janeiro and São Paulo, usually in montane forests above 1.500 m (Zappi et al. 2007).


The number of perianth segments and stamens observed is lower than those reported by Zappi et al. (2007). In this study ca. 67 stamens were counted and ca. 11 perianth segments, while in Zappi et al. (2007) counted ca. 70 stamens and 13-14 perianth segments.


Epiphytes. Cladodes acrocaulous, 2-3-branched, cylindrical, 17-40.5 cm long, 3-4 mm diameter, pendulous. Flower lateral, saucer shaped, 1 per areole, 0.8-1.2 cm diameter; perianth segments 11, the external 3 × 3 mm, triangular, white, the internal 2 × 5-5.5 mm, lanceolate, white; pericarpel 2 × 3 mm hemispheric, greenish, immersed; stamens ca. 38, 3-4.5 mm long, white, exserted; style white, ca. 5 mm long, exserted, stigma 3-lobed, lobes ca. 1 mm long. Fruit intense yellow, globose, 1 per cladode, 5-6 × 5-6 mm. Seeds with black colour, ca. 0.5 × 1 mm, 2-5 per fruit.

Phenology and habitat: Fruits were collected in June and August. The species occurs in Rio de Janeiro, São Paulo, Paraná, Santa Catarina and Rio Grande do Sul (Zappi et al. 2007).

Specimens examined: BRASIL. SÃO PAULO: Santo André, Distrito de Paranapiacaba, Paranapiacaba Biological Reserve, 6-VI-1991, N. Taylor &
E. Gonçalves 1636 (SP); Fumaça Valley, 23-VIII-2009, Z.R. Mendes 19 (UNIP).


It is found within PBR and Fumaça Valley areas. Zappi et al. (2007) describe the flower of *R. puniceodiscus* with 12 to 14 perianth segments, ranging its color from white, pale yellowish to green according to the position; having 70-110 stamens with yellowish apex, and a reddish or orange base. Zappi et al. (2007) described stamens with reddish or orange base and yellowish apex. This species was considered a rare occurrence in Rio de Janeiro State by Calvente et al. (2005).


Epiphytes. Cladodes acrocaulous, 3-branched, cylindrical, 5.3-8.7 cm long, up to 2 mm diameter, suberect. Flower lateral or subterminal, saucer shaped, 1 per areole, 0.6-0.8 cm diameter; perianth segments 8, the external 3 × 4 mm, triangular, bright brown, the internal 5 × 2 mm, lanceolate, white; pericarpel ca. 2 × 2 mm, hemispheric, greenish, emerged; stamens ca. 25, up to 4 mm long, white, same height of style; style white, ca. 4 mm long, stigma 3-lobed, lobes ca. 1 mm long. Fruit green to white, pale blue violet or reddish when ripe, globose, up to 2 per cladode. Seeds with black colour, ca. 0.5 × 1 mm, 3-7 per fruit.

Phenology and habitat: Flowers and fruits were collected in March. It is a widely distributed species, occurring in southern and southeastern Brazil (Zappi et al. 2007).


The measures of the cladodes of *R. teres* mentioned in this study are higher than those reported by Zappi et al. (2007). In this study the cladodes were measured 5.3-8.7 cm long, while in Zappi et al. (2007) the cladodes were measured 2.5 cm long.

Cactaceae showed no preference for a specific tree bark, since all species were found on several types of stems, more frequently the ones that support greater amount of substrate. The epiphytic cacti species in PBR seem to prefer shaded environments to environments with a medium luminosity; and very humid habitats, close to rivers or lakes.

Part of the reproduction of the species analyzed can occur by fragmentation of the cladodes and the broken parts produce roots that can reach the substrate and continue its growth. Their dispersal is by zoochory. Boeni & Pizo (2007) observed and described some bird species feeding the fruits of *R. teres*: Coereba flaveola Linnaeus 1758, Euphonia pectoralis Latham 1802, Euphonia cyanoccephala Vieillot 1818 and Turdis rufiventris Vieillot 1818. These mutualistic relationships suggest that of conservational projects aiming the conservation of both cacti and birds are needed, since some of these birds have exuberant plumage and therefore are targets for hunters. The color and odor of *R. juengeri* fruits are attractive to bats (Schlumpberger et al. 2006).

An ecological relationship was observed between a species of arachnid and a species of *Rhipsalis*, in some environments and seasons. When disturbed, the spider showed a camouflage system, stretching its body like a cladode. The spider was not collected but species of some families (Therididae, Deinopidae, and Uloboridae) have this behavior to keep their body stretched and paralyzed, mimicking twigs (Jocqué & Dippernaar-Shoeman 2006). The spider uses the branches of the plant to build its web and protecting against small predators.

According to the Paranaícapaca Biological Reserve Phanerogamic Flora, there are seven species of Cactaceae in this area (Kirizawa et al. 2009), but *R. pulvinigera* was currently treated as *R. floccosa* subsp. *pulvinigera* (Zappi et al. 2007). However, for this study eight species were recognized in the Reserva Biológica do Alto da Serra de Paranaícapaca and six species in its surrounding areas, which had not been previously considered. *R. burchelli* and *R. olivifera* are new records for the reserve, while the other species discussed here, *R. baccifera*, *R. juengeri*, *R. neves-ARMONDII*, *R. PARADOXA* and *R. pulchra* were collected in surrounding areas. The latter three deserve special attention on *R. neves-ARMONDII*, *R. olivifera* and *R. pulchra* are considered near threatened due to restricted distribution in the São Paulo State, occurring only in conservation areas (Mamede et al. 2007).
The species cited in this study do not appear in Appendix 1 of CITES (2011), thus they are not considered endangered. However, all other Cactaceae species that are not in Appendix 1 appear in Appendix 2 of CITES (2011) and its commercialization should be compatible with their preservation. According to the red list of threatened species of flora (IUCN 2010), *L. houlletianum*, *R. elliptica*, *R. floccosa*, and *R. paradoxa* are classified as Least Concern.

About 174 species of Cactaceae that occur in Brazil are endemic (Zappi et al. 2010). Among the native species of Brazil, 43 occur in Atlantic Forest areas of São Paulo State. PBR and its surroundings contain about one-third of this diversity (14 species), emphasizing the importance of District of Paranapiacaba for the conservation of Cactaceae in São Paulo State.

Three species occurring in PBR are not endemic to the Atlantic Forest, *L. houlletianum*, *R. baccifera* and *R. floccosa* (Zappi et al. 2010). The lack of floristic studies can influence the recently published rates of plant species endemism (Myers et al. 2000). Thus, the data presented here can contribute to strategies for preserving Atlantic Forest areas.

Of the fourteen species observed here, three are cited for Ilha do Cardoso (São Paulo State, Brazil): *L. houlletianum*, *R. campos-portoana* and *R. teres* (Rodrigues & Barros, 2008). This reinforces the high diversity of Cactaceae in Reserva Biológica do Alto da Serra de Paranapiacaba.

Bruxel & Jasper (2005) found five genera and eleven species in Rio Taquari watershed in Rio Grande do Sul (Brazil). Seven were epiphytic, *Lepismium cruciforme*, *L. houlletianum*, *L. lumbricoides*, *L. warmingianum*, *Rhipsalis cereuscula*, *R. floccosa*, and *R. teres*. *L. houlletianum*, *R. floccosa*, and *R. teres* also occur in PBR.


The results suggest that even though Reserva Biológica do Alto da Serra de Paranapiacaba is considered an area of restricted biodiversity, it would have an even greater importance if its boundaries were extended. This means that a greater number of species could be protected with the increase of its total area.

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**Literature cited**


