Selbyana 30(1): 107–113. 2009.

BROMELIADS IN THE EXTREME SOUTH OF THE ESPINHAÇO RANGE, MINAS GERAIS, BRAZIL

OTÁVIO BATISTA DE CASTRO RIBEIRO

Department of Vegetable Biology, Federal University de Viçosa, MG. Brazil. Researcher of the Unit for Research and Conservation of Bromeliaceae, P.H. Holfs Avenue, 36571-002, Viçosa, MG, Brazil.

CLÁUDIO COELHO DE PAULA*

Professor of the Department of Vegetable Biology, Federal University de Viçosa, Researcher of the Unit for Research and Conservation of Bromeliaceae, P.H. Holfs Avenue, 36571-002, Viçosa, MG, Brazil. Email: ccpaula@ufv.br

ABSTRACT. This work presents a floristic survey of Bromeliaceae of Serra Bico de Pedra and Serra de Itatiaia in the district of Ouro Preto, Minas Gerais. The studied area is located in the south of the Espinhaço Range. It presents a typical physiognomy of grasslands on rocky soils, quartzitic rocky outcrops, gallery forest, grasslands, swamplands, and grasslands of Velloziaceae. In the studied area, there are 12 species of Bromeliaceae distributed in six genera and three subfamilies: Tillandsioideae: *Vriesea minarum* L.B.Sm., *V. friburgensis* var. *tucumanensis* (Mez) L.B.Sm., *V. atropurpurea* Silveira, *V. oligantha* (Baker) Mez, *Tillandsia stricta* Sol. ex Sims var. *stricta, T. gardneri* Lindl. *T. geminiflora* Brongn. var. geminiflora; Bromelioideae: *Cryptanthus lavrasensis* Leme, *Aechmea nudicaulis* var. *aureorosea* (Antoine) L.B.Sm., *A. bromeliifolia* (Rudge) Baker var. *bromeliifolia, Billbergia vittata* Brongn. ex Morel, and Pitcairnioideae: *Dyckia bracteata* (Wittm.) Mez. Presented here in this work are an artificial key, descriptions, illustrations, and ecological comments.

Key words: Bromeliaceae, floristic, grasslands on rocky soils, Espinhaço Range

INTRODUCTION

The Bromeliaceae family presented here has two centers of generic diversity: the East Coast of Brazil, in the domains of the Atlantic Rainforest, where groups closely associated to the forest environment predominate; and in the Guiana Shield, where related groups stand-out from the open vegetation. It is estimated that from the total of 3086 species of Bromeliaceae (Luther 2006), nearly 40% could be found in Brazil, placing this country among the most important in terms of familial diversity. Of the 58 genera, nearly 80% are found in Brazilian territory, meaning that of these, approximately 22% are restricted to Brazil (Leme 1997).

The grasslands on rocky soils constitute a combination of mountain ranges that occur from the south-central region of the state of Minas Gerais to the central region of the state of Bahia. Its predominant plant formations are the quartizitic grasslands on rocky soils that are established at over 900 m altitude with the predominance of herbaceous species among the Bromeliaceae (Paula et al. 2005). For the grasslands on rocky soils, the Bromeliaceae present great diversity of species having a very high incidence of endemism (Leme & Marigo, 1993).

Studies about the diversity of Bromeliaceae in of the grasslands on rocky soils in the extreme south of the Espinhaço Range are therefore necessary for the knowledge and conservation of this family. The objective of this pioneer study of the family in this region is to take a floristic inventory of the Bromeliaceae in the extreme south of the Espinhaço Range.

MATERIALS AND METHODS

The study was realized in the Serras of the Bico de Pedra and Itatiaia (average coordinates 20°27.17′1″S and 43°35.20′9″W), in the municipality of Ouro Preto, located in the state of Minas Gerais. These Serras are found in the south of the Espinhaço Range, in the southeast of Brazil. They form a part of the Planalto Quartzítico Mineiro, within the southern limit of the Quadrilátero Ferrífero. The ecosystem of these Serras is characterized with the grasslands on rocky soils, showing five physiognomies: quartzitic rocky outcrops, gallery forest, grasslands, swamplands, and grasslands of Velloziaceae (Paula et al. 2005).

The collection of the fertile material was performed in the monthly excursions, from Septem-

* Corresponding author.

ber 2004 to September 2007, through random hikes that crossed through all of the integrated physiognomies of the grasslands on rocky soils of these Serras. The botanical material was herborized and stored in the Herbarium of the Department of Plant Biology of the Universidade Federal de Viçosa (VIC). The identification was performed through specialized literature: Smith and Downs (1974, 1977, 1979) and Mez (1894).

The key to the species and its respective descriptions are justified in the morphological variability observed in the collected material of the area.

Results and Discussion

In the studied area, the Bromeliaceae are represented by twelve species, distributed in six genus and three subfamilies: Tillandsioidae: *Vriesea minarum* L.B.Sm., *V. friburgensis* var. *tucumanensis* (Mez) L.B.Sm., *V. atropurpurea* Silveira, *V. oligantha* (Baker) Mez, *T. gardneri* Lindl., *T. geminiflora* Brongn. var. *geminiflora, Tillandsia stricta* Sol. ex Sims var. *stricta*; Bromelioideae: *Cryptanthus lavrasensis* Leme, *Aechmea nudicaulis* var. *aureorosea* (Antoine) L.B.Sm., *A. bromeliifolia* (Rudge) Baker var. *bromeliifolia, Billbergia vittata* Brongn. ex Mouel, and Pitcairnioideae: *Dyckia bracteata* (Wittm.) Mez.

Artificial Key for the Species of Bromeliaceae in the South of the Espinhaço Range:

1. Serrate leaf margins.
   2. Succulent leaves, scape lateral . . . . . 5. *Dyckia bracteata*
   2′. Coriaceous leaves, scape terminal or not present.
      3. Plant flowering ca. 10 cm tall, scape not present . . . . . 4. *Cryptanthus lavrasensis*
      3′. Plant flowering over 10 cm tall, scape present
         4. Scape sub-erect or pendent . . . . . 3. *Billbergia vittata*
         4′. Scape erect
            5. Inflorescence espiciform . . . . . 2. *Aechmea nudicaulis*
            5′. Inflorescence estrobilate . . . . . 1. *Aechmea bromeliifolia*

1′. Full leaf margins.
   6. Tank not present, petal appendices not present.
      7. Inflorescence simple . . . . . 8. *Tillandsia stricta*
      7′. Inflorescence compound.
         8. Leaf-blades cinereous, floral bracts rose, lepidote . . . . . 6. *Tillandsia gardneri*
         8′. Leaf-blades light green until the middle portion, wine-colored in the terminal portion, floral bracts red . . 7. *Tillandsia geminiflora*
   6′. Tank present, petal appendices present.
      9. Epiphytic
         10. Inflorescence simple . . . . . 12. *Vriesea oligantha*
         10′. Inflorescence compound . . . . . 10. *Vriesea friburgensis*
      9′. Rupicolous, saxicolous or terrestrial
         11. Leaves erect, scape short (ca. 50.0 cm) . . . . . 11. *Vriesea minarum*
         11′. Leaves sub-erect, scape long (ca. 170.0 cm) . . . . . 9. *Vriesea atropurpurea*

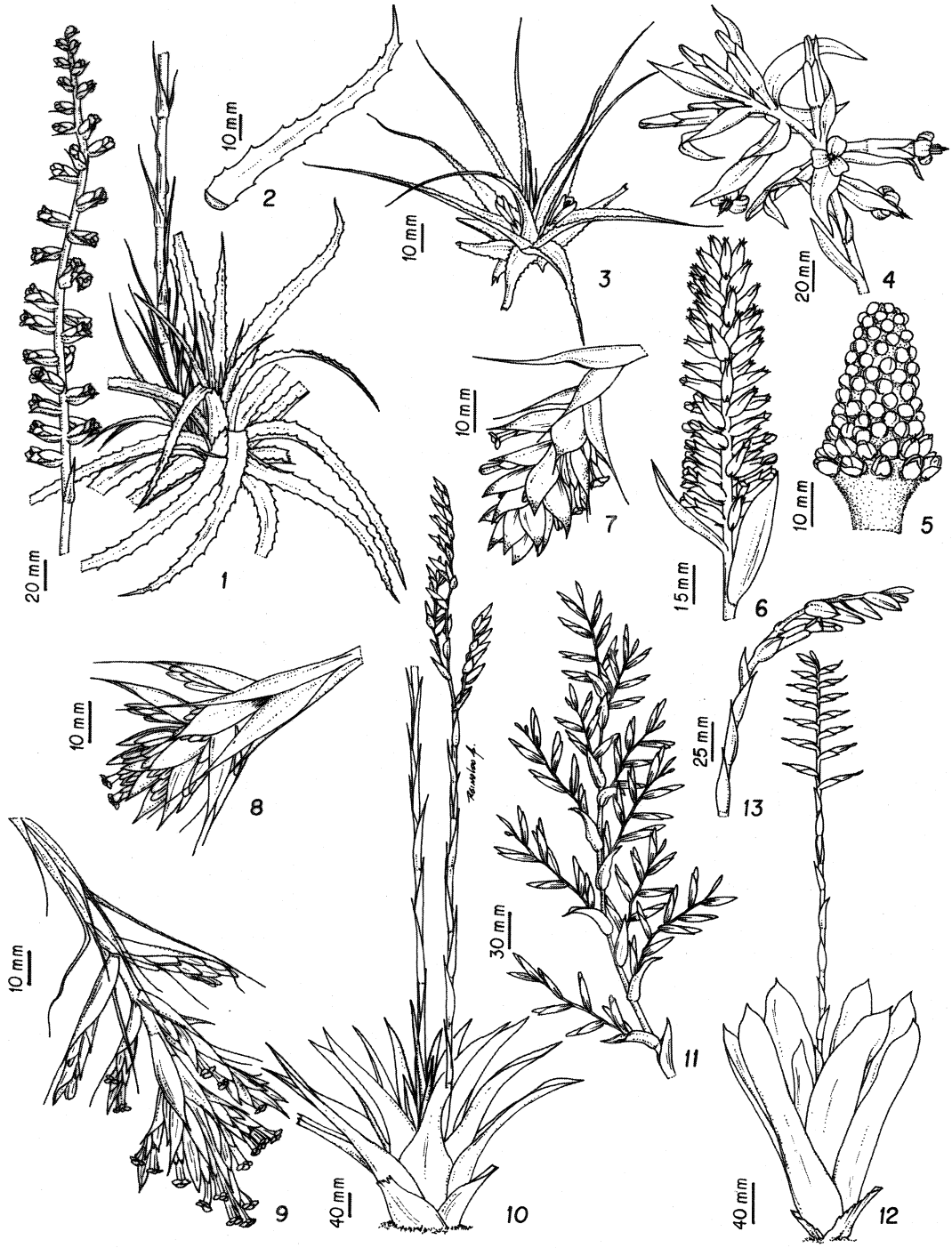
1. *Aechmea bromeliifolia* (Rudge) Baker var. ***bromeliifolia,*** in Bentham & Hooker filius, Gen. Pl. 3: 664. 1883. FIGURE 5.

Plant epiphytic, rupicolous or saxicolous, heliophilas or sciaphilas, plant flowering ca. 50.0 cm tall. ***Leaves*** erect, coriaceous, tank-forming; sheaths elliptic, wine-colored adaxially; leaf-blades ligulate, coriaceous, margins serrate. ***Scape*** erect, rose, partially covered with scape bracts. Scape-bracts lanceolate, red. ***Inflorescence*** simple, estrobilate, white-lanate. Floral bracts reniforms, violet, bicarenate, apex truncating. ***Flowers*** polystichous, yellow, tubular; sepals elliptic, white with macules rose in the apex, united in the base, apex acute; petals oblong, yellow in the apex and whitish at base, becoming black before the anthesis, apex acute, petal appendices fimbriated; stamens epipetalous, included; ovary lepdote, light-yellow; stigma included. ***Fruit*** berry.

Comments. *Aechmea bromeliifolia* var. *bromeliifolia* can be found in Central America (México, Guatemala, El Salvador and Honduras), in the northeast of South America (Guianas, Suriname, Trinidad and Tobago; Venezuela, Colombia, Peru, and Bolivia) and Brazil, in the states of Maranhão, Ceará, Bahia, Minas Gerais, São Paulo, Tocantins, Goiás; in the Distrito Federal, Mato Grosso, Amapá, Roraima, Pará, Amazonas and Rondônia (Faria 2006). In the studied area, they generally occur as epiphytic in gallery forests and sporadically in small trees in the rocky outcrops. Faria (2006) agrees that the species presents two varieties: var. *bromeliifolia* and *albobracteta* Philcox that differ by wine-colored scape, rose scape bracts, floral bracts wine-colored (vs. white scape and scape bracts, floral bracts green).

2. *Aechmea nudicaulis* (L.) Griseb. var. ***aureorosea*** (Antoine) L.B.Sm., Smithson. Misc. Collect. 126: 17, 220, 1955. FIGURE 6.

Plants epiphytic, rupicolous or saxicolous,



FIGURES 1–13. **1.** Lateral scape *Dyckia bracteata* (Wittm.) Mez.; **2.** Detail from the succulent leaf in *Dyckia bracteata* (Wittm.) Mez.; **3.** *Cryptanthus lavrasenis* Leme in flowering; **4.** Scape sub-erect in *Billbergia vittata* Brongn. ex Morrel; **5.** Inflorescence estrobilate in *Aechmea bromeliifolia* (Rudge) Baker; **6.** Inflorescence espiciform in *Aechmea nudicaulis* (L.) Grisebach var. *aureo-rosea* (Antoine) L.B.Sm.; **7.** Inflorescence simple in *Tillandsia stricta* (Sol.) var. *stricta*; **8.** Inflorescence in *T. geminiflora* Brongn. var. *geminiflora*; **9.** Inflorescence in *Tillandsia gardneri* Lind.; **10.** *Vriesea atropurpurea* Silveira in flowering; **11.** Inflorescence compound in *Vriesea friburgensis* Mez var. *tucumanensis* (Mez) L.B.Sm.; **12.** *Vriesea minarum* L.B.Sm. in flowering; **13.** Inflorescence simple in *Vriesea oligantha* (Baker) Mez.

heliophilas or sciaphilas, plant flowering 40 cm tall. ***Leaves*** erect, coriaceous, tank-forming; sheaths of little difference; leaf blades lingulate, green with macules violet, margins serrate. ***Scape*** erect, rose, lanate. Scape-bracts lanceolate, rose. ***Inflorescence*** espiciform, rhachis rose, lanate. Floral bracts elliptic, yellowish. ***Flowers*** polystichous, yellow, tubular; sepals ovate, rose, margins whitish, connate, apex mucronate; petals elliptic, white on the base, purple in the middle portion, yellow on the apex, apex cuspidate, appendices petals fimbriated; stamen epipetalous, included; ovary sub-globular, rose, lanate; stigma included. ***Fruit*** berry.

Comments. *Aechmea nudicaulis* is a species with great dispersion in Central and South America. The variety *aureorosea* occurs only in the states of Minas Gerais, Espirito Santo, Rio de Janeiro and Sao Paulo (Smith & Downs 1979). It occurs in the studied area as saxicolous, rupicolous or epiphytic, not specifically showing much phorophyte, occurring in the rocky outcrops and gallery forests. It differs from the typical variety with floral bracts elliptic and white petals on the base, purple in the middle portion, yellow on the apex (vs. floral bracts reniforms and petals yellow).

3. *Billbergia vittata* Brongn. ex Morel, Portef. Hort. 2: 353, *pl.* 1848. FIGURE 4.

Plants epiphytic, sciaphilas, plant flowering ca. 70.0 cm tall. ***Leaves*** erect, coriaceous tank-forming; sheaths slightly elliptic, dark green; leaf blades erect, dark green with white horizontal stripes, margins serrate. ***Scape*** sub-erect to pendent, purplish-green partially covered with scape-bracts. Scape-bracts lanceolate rose. ***Inflorescence*** compound, rhachis glabrous. Bracts primary, lanceolate, rose. Floral bracts sub-triangular rose. ***Flowers*** blue, tubular; sepals oblong, rose, free, apex mucronate; petals oblong, whitish on the base, dark blue on the remainder, apex retuse, appendices petals triangular; stamens epipetalous, exserted; ovary cylindrical, sulcate, purplish-green; stigma exserted. ***Fruit*** berry.

Comments. *Billbergia vittata* occurs only in Brazil, in the states of Minas Gerais, Espírito Santo and Rio de Janeiro (Smith & Downs 1979). In the studied area, it occurs only in the Serra of Itatiaia being encountered by a few individuals like epiphytes in the gallery forest at 1.264 m. According to the Fundação Biodiversitas (2007), the conservation status of *Billbergia vittata* is endangered.

4. *Cryptanthus lavrasensis* Leme, J. Bromeliad Soc. 57(6): 259. 2007. FIGURE 3.

Plants saxicolous, heliophiles, plant flowering ca. 10.0 cm tall. ***Leaves*** sub-erect, coriaceous, not tank-forming; sheaths suborbicular, whitish; leaf blades narrow-triangular acanalate, cinereous-green, margins serrate. ***Scape*** not present. ***Inflorescence*** simple. Floral bracts foliaceous, acanalate, exceding the flowers. ***Flowers*** distinctly pedicelate, white, tubular; sepals lanceolate, united at the base, greenish-white, apex acute; petals lanceolate, united at the base white, apex acute; stamens epipetalous, included; ovary compressed, greenish-white; stigma included. ***Fruit*** berry.

Comments. *Cryptanthus lavrasensis* occur only in the district of Lavras Novas, in the municipalities of Ouro Preto, Minas Gerais. According to Leme (2007), *C. lavrasensis* occur in dense terrestrial communities with humid soil. However, in the studied area, this species occurs in unique rosettes, saxicolous in rocky outcrops developing in the lateral cracks of the rocks and very sporadically on top of the rocks. *C. lavrasensis* can be distinguished from *Cryptanthus schwackeanus* Mez by inflorescence simple (vs. bipinnate) and the floral bract foliaceous (vs. bracteiform) (Leme 2007).

5. *Dyckia bracteata* (Wittm.) Mez, *in* Martius, Fl. Bras. 3 (3): 470.1894. FIGURES 1, 2.

Plants terrestrials, saxicolous, rupicolous rare, heliophilas, plant flowering ca. 90.0 cm tall. ***Leaves*** sub-erect, succulent, not tank-forming; sheaths reniforms, acanalate, less differentiated; leaf blades narrow-triangular, slightly curved, succulents, green to wine-colored on the face adaxially, lanate green on the face abaxially, margins serrate. ***Scape*** lateral, erect, wine-colored, partially lanate. Scape-bracts narrow-triangular, wine-colored, lanate, apex acuminate. ***Inflorescence*** simple, erect, rhachis brown, partially covered with cottony hairs. **Floral** bracts triangular, brown, larger than the flowers, margins serreate. ***Flowers*** polystichous; sepals ovate, reddish, apex obtuse-cuspidate; petals espatulate, orangish, apex obtuse; stamens epipetalous, included, ovary, yellowish; stigma included. ***Fruit*** capsule.

Comments. *Dyckia bracteata* occurs only in Brazil, in the state of Minas Gerais, having the location type of Serra do Ouro Branco, extreme south of the Espinhaço Range (Smith & Downs 1974), adjacent to the studied area. It occurs as terrestrial in grassy fields, in the rocky outcroppings with saxicolous rare rupicolous. This species is highly fire-resistant, keeping the internal leaves of the rosette practically intact after a fire.

6. *Tillandsia gardneri* Lindl., Bot. Reg. 28: sub pl. 63. 1842. FIGURE 9.

Plants epiphytic, sciaphilas, plant flowering ca. 28.0 cm tall. ***Leaves*** sub-erect, tank not present; sheaths less differentiated, whitish; leaf blades linear, acanalate, cinereous, margins smooth. ***Scape*** pendent, rose, totally covered with scape-bracts. Scape-bracts elliptic acuminate, cinereous. ***Inflorescence*** compound, pendent, rhachis grayish-green; primary bracts elliptic, rose. Floral bracts lanceolate, carenate, larger than the sepals, rose, lepidote. ***Flowers*** sessile, tubular; sepals elliptic, rose, free, apex acute; petals espatulate, wine-colored to the apex, free, apex obtuse; stamens free, included; ovary globose, light green; stigma included. ***Fruit*** capsule.

Comments. *Tillandsia gardneri* occurs in Colombia, Venezuela, Trinidad and Brazil in the following states: Piauí, Ceará, Pará, Pernambuco, Bahia, Espírito Santo, Minas Gerais, Rio de Janeiro, Sao Paulo, Paraná, Santa Catarina, and Rio Grande do Sul (Smith & Downs 1977). In the studied area, it occurs only in the Serra Bico de Pedra, where only one community was found at 1.256 m in altitude, containing hundreds of individual epiphytes in the unique tree of *Podocarpus selowii* Klotzsch (Podocarpaceae).

7. *Tillandsia geminiflora* var. ***geminiflora*** Brongn. in Duperrey, Voy. Coquille 186. 1829. FIGURE 8.

Plants epiphytic, sciaphilas, plant flowering ca.15.0 cm tall. ***Leaves*** sub-erect, tank not present; sheaths less differentiated, whitish; leaf blades linear, light green until the middle portion, wine-colored in the portion terminal, margins smooth. ***Scape*** pendent, rose, totally covered by scape-bracts. Scape-bracts elliptic, wine-colored. ***Inflorescence*** compound, pendent, rhachis rose; bracts primary elliptic, wine-colored flowers. Floral bracts elliptic, red. ***Flowers*** pedicelate, tubular, sessile; sepals elliptic, rose, connate, apex acuminate; petals espatulate, white on the base, rose to the apex, free, apex obtuse; stamens free, included; ovary globoso, light green; stigma included. ***Fruit*** capsule.

Comments. *Tillandsia geminiflora* var. *geminiflora* occurs in the northeast of Argentina, Uruguay, Paraguay and Brazil, in the states of Goiás, Distrito Federal, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Espírito Santo, Rio de Janeiro, São Paulo, Paraná, Santa Catarina, and Rio Grande do Sul. (Smith & Downs 1979, Reitz 1983). In the studied area, it occurs only in the Serra de Itatiaia, in gallery forests, where also the occurrence of *Billbergia vittata* was verified.

8. *Tillandsia stricta* Sol. ex Sims var. ***stricta*** Bot. Mag. 37: *pl. 1529.* 1813. FIGURE 7.

Plants epiphytic, heliophilas, plant flowering ca. 20.0 cm tall. ***Leaves*** sub-erect, cinereous, tank not present; sheaths less differentiated, white; leaf blades linear-acanalate, cinereous, margins smooth. ***Scape*** pendent, green, totally covered with scape- bracts. Scape bracts lanceolate, cinereous. ***Inflorescence*** simple, rhachis rose. Floral bracts elliptic, rose. ***Flowers*** polystichous, tubular, sessile; sepals elliptic, rose, connate, apex acuminate; petals espatulate dark-blue, free, apex obtuse; stamens epipetalous, included; ovary globose, light green; stigma included. ***Fruit*** capsule.

Comments. There is an ample distribution of *Tillandsia stricta,* occurring in Venezuela, Trinidad, Guianas, Suriname, Brazil, Paraguay, Uruguay and north of Argentina. In Brazil, it occurs in the states of Pernambuco, Bahia, Espírito Santo, Minas Gerais, Rio de Janeiro, São Paulo, Paraná, Santa Catarina, and Rio Grande do Sul (Smith & Downs 1977). In the studied area, it occurs as epiphytic in different phorophytes.

9. *Vriesea atropurpurea* Silveira, Floral. Mont. 2: 3. 1931. FIGURE 10.

Plant terrestrial, skiophilous, flowering ca. 2.0 m tall. ***Leaves*** sub-erect, tank present; sheaths elliptic, light green; leaf blades lingulate, green, margins smooth. ***Scape*** erect, ca. 1.7 m comp. brownish-green, totally covered with scape-bracts. Scape-bracts lingulate, brownish. ***Inflorescence*** compound, erect, rhachis brownish-green. Primary bracts lingulate, smaller than the internodes, brownish-green. Floral bracts elliptic, brownish, sterile bracts present. Flowers tubular, greenish-yellow, short pedicels; sepals oblong-elliptic, yellow-green with small purple points, free, apex obtuse; petals elliptic, yellow, apex retuse, appendices petals triangular; stamens free, exserted; ovary conical, yellowish; stigma exserted. ***Fruit*** capsule.

Comments. *Vriesea atropurpurea* is a species considered endemic in Serra do Cipó, its location type (Versieux & Wendt, 2006). The area of distribution occurs from Serra de Itatiaia into the Cadeia do Espinhaço. In the studied area, they occur as only four individuals restricted to Serra de Itatiaia, at 1.321 m in altitude, in the transition from rocky outcrops to gallery forest. According to the Fundação Biodiversitas (2007) the conservation status of *Vriesea atropurpurea* is vulnerable.

10. *Vriesea friburgensis* var. ***tucumanensis*** (Mez) L.B.Sm., Anais Bot. Herb. "Barbosa Rodrigues" 4: 68. 1952. FIGURE 11.

Plants epiphytic, sciaphilas, plant flowering ca. 50.0 cm tall. ***Leaves*** sub-erect, tank present,

sheaths elliptic, purplish on both faces; leaf blades lanceolate, purplish-green, margins smooth. ***Scape*** erect, reddish, totally covered with scape-bracts. Scape-bracts ligulate, larger than the internodes, purplish-red. ***Inflorescence*** compound, erect, rhachis red; bracts primary lanceolate to elliptic, purple to yellowish, margins smooth, apex cuspidate; racemes geniculate. Floral bracts lanceolate, yellow, carenate. ***Flowers*** distichous, tubular, short pedicels; sepals lanceolate, yellow, free, apex acute; petals lanceolate, whitish on the base and yellow on apex, free, apex acute, appendices petals narrow-triangular; stamens epipetalous, exerted; ovary conical, white; stigma exserted. ***Fruit*** capsule.

Comments. *Vriesea friburgensis* occurs from the north of Argentina and Paraguay to Southeast Brazil at altitudes around 700–900 m. In Brazil it occurs in the states of Minas Gerais, Bahia, São Paulo, Paraná, Santa Catarina and Rio Grande do Sul (Smith & Downs 1977). A var. *tucumanensis* varies from the typical variety with branches spreading to arching-recurved, lax (vs. branches erect or suberect). In the studied area, it is found in gallery forests as epiphytic and not showing a specific relation to the phorophytes.

11. *Vriesea minarum* L.B.Sm., Arq. Bot. S. Paulo II. 1: 118, *pl. 126.* 1943. FIGURE 12.

Plants rupicolous or saxicolous, heliophilas, plant flowering ca. 60.0 cm tall. ***Leaves*** erect, tank present; sheaths less differentiation, whitish-green; leaf blades lingulate, cinereous-green margins smooth. ***Scape*** erect, ca. 50.0 cm, light green, partially covered with scape-bracts. Scape-bracts lanceolate, less than the internodes, brown with violet spots. ***Inflorescence*** simple or compound, rhachis green with violet spots; bracts primary obovate, brown with violet spots, apex acute. Floral bracts obovate, light green with violet spots. ***Flowers*** distichous on the anthesis, yellow, tubular, short pedicels; sepals elliptic, yellow with purple spots on the base, free, apex acute; petals oblong, yellow on the apex and whitish on the base, apex acute, appendices petals triangular; stamens epipetalous, exserted; ovary conical, light-yellow; stigma included. ***Fruit*** capsule.

Comments. *Vriesea minarum* is endemic to the Quadrilátero Ferrífero of Minas Gerais, where it occurs in gravels of iron ore. (Versieux 2005). The same author asserts that one can find this plant with many different names in an herbaria, principally: *V. atropurpurea* A. Silveira, *V. crassa* Mez, *V. lancifolia* (Baker) L.B.Sm., *V. ouroensis* W. Weber, and *V. stricta* L.B.Sm. In the studied area, it occurs as saxicolous or rupicolous in quartzitic rocky outcrops. According to the Fundação Biodiversitas, (2007) *Vriesea minarum* this plant has a conservation status of vulnerable.

12. *Vriesea oligantha* (Baker) Mez in Mart., Eichler & Urban, Fl. Bras. (Martius) 3(3): 544. 1894. FIGURE 13.

Plants epiphytic, heliophilas, plant flowering ca. 55.0 cm tall. ***Leaves*** erect, tank present; sheaths elliptic, green; leaf blades lanceolate, cinereous, with violet spots, margins smooth. ***Scape*** erect, light green, partially covered with scape-bracts. Scape bracts lanceolate, smaller than the internodes, cinereous-green with violet spots. ***Inflorescence*** simple, rhachis yellowish-green, flexuous. Floral bracts elliptic, yellowish-green, with longitudinal violet stripes. ***Flowers*** secund on the anthesis, greenish-yellow, tubular, sessile; sepals elliptic, yellow, free, apex mucronate; petals elliptic, greenish-yellow, apex retuse, appendices petals triangular; stamens epipetalous, included; ovary conical, yellowish; stigma included. ***Fruit*** capsule.

Comments. This species occurs in the states of Minas Gerais and Bahia along the Espinhaço Range. Its location type is Serra do Ouro Branco (Smith & Downs 1977, Coffani-Nunes 1997) adjacent to the area of study where they occur abundantly. In the area of study, only three distantly separate individuals were found distributed in the Serra de Itatiaia occurring exclusively with epiphytic in *Vellozia compacta* Mart. ex Schult. as indicated by Paula and Guarçoni (2005) in the Serra do Ouro Branco. No individual was found anywhere like saxicolous or rupicolous, as were already observed in other locations of the Espinhaço Range (Coffani-Nunes 1997). This observation can subsidize future taxonomic studies. According to the Fundação Biodiversitas, (2007) *Vriesea oligantha* has a conservation status of vulnerable.

ACKNOWLEDGMENTS

The authors thank the Unit for Research and Conservation of Bromeliaceae (UPCB/UFV) for technical and logistical support, to Elton Leme for help with the botanical identifications, and to Bruno Rodrigues and Kamil Cheab for helping with the field collections.

LITERATURE CITED

Coffani-Nunes, J.V. 1997. Estudo florístico e fenomorfológico de Tillandsioideae—Bromeliaceae na

Serra do Cipó, MG. M.S. diss., Universidade São Paulo, São Paulo.

Faria, A.P.G. 2006. Revisão taxonômica e filogenia de *Aechmea* Ruiz & Pav., subg. *Macrochordion* (de Vriese) Baker, Bromelioideae-Bromeliaceae. Ph.D. diss., Universidade Federal do Rio de Janeiro, Rio de Janeiro.

Fundação Biodiversitas. 2007. Revisão da Lista da Flora e da Fauna Brasileira Ameaçada de Extinção (www.biodiversitas.org.br).

Leme, E.M.C. 1997. Bromélias da Mata Atlântica: *Canistrum.* Salamandra. Rio de Janeiro.

Leme, E.M.C. and L.C. Marigo,1993. Bromélias na natureza. Marigo Comunicação Visual Ltda. Rio de Janeiro.

———. 2007. Three subtle new *Cryptanthus* species from Espinhaço Range, Minas Gerais, Brazil. Journal Bromeliad Society 57(6): 259–271.

Luther, H.E. 2006. An Alphabetical List of Bromeliad Binomials, 10th ed. The Marie Selby Botanical Gardens Sarasota, Florida.

Paula, C.C. and E.A.E. Guarçoni. 2007. *Vriesea oligantha*: an obligate epiphyte of Velloziaceae. Journal Bromeliad Society 55(5): 195–198.

Paula, C.C., R.R. Silva, and D.A.S. Oliveira. 2005. A Serra do Ouro Branco. Viçosa, Universidade Federal de Viçosa.

Reitz, R. 1983. Bromeliáceas e a Malária-Brornélia Endêmica. Fl. Ilustr. Catarinense, Parte I. Fasc. Brom.

Smith, L.B. and R.J. Downs. 1974. Pitcairnioideae (Bromeliaceae). Flora Neotropica 14(1): 1–660. The New York Botanical Garden, New York.

———. 1977. Tillandsoideae (Bromeliaceae). Flora Neotropica Monograph, 14(2): 661–1492. The New York Botanical Garden, New York.

———. 1979. Bromelioideae (Bromeliaceae). Flora Neotropica Monograph, 14(3):1493–2142. The New York Botanical Garden, New York.

Versieux, L.M. 2005. Bromeliáceas de Minas Gerais: catálogo, distribuição geográfica e conservação. M.S. diss., Universidade Federal do Rio de Janeiro.

Versieux, L.M. and T. Wendt 2006. Checklist of Bromeliaceae of Minas Gerais, Brazil, with notes on taxonomy and endemism. Selbyana 27(2): 107–146. 2006.

Selbyana 30(1): 114–121. 2009.

PRIOR AUTONOMOUS SELFING IN THE HUMMINGBIRD-POLLINATED EPIPHYTE *TILLANDSIA MULTICAULIS* (BROMELIACEAE)

STEPHEN P. BUSH

Coastal Carolina University, P.O. Box 261954, Conway, SC, 29528, USA.
Email: bush@coastal.edu

ABSTRACT. *Tillandsia multicaulis* is an epiphytic bromeliad found in montane forests from Panama to Mexico. In Veracruz, Mexico, *T. multicaulis* is self-incompatible. However, in Monteverde, Costa Rica, large amounts of self-pollen are transferred autonomously to the stigma before and during floral opening. I hypothesized that *T. multicaulis* is self-compatible and capable of autonomous self-pollination in Costa Rica, and I examined the breeding system of one population in Monteverde. Fruit and seed set were high in open-, self-, and cross-pollinated treatments, and in caged, unmanipulated flowers. Flowers emasculated two days before opening did not set fruit. Therefore, *T. multicaulis* is self-compatible and autogamous, but not agamospermous in Monteverde. Prior selfing occurs during the day before anthesis. Fruit set ranged from 22–32% in emasculation treatments performed the day before anthesis to 78% among flowers emasculated within one hour after floral opening. Although plants in Monteverde offer pollen and nectar rewards and are visited by pollen-collecting bees and hummingbirds, past pollen limitation has likely driven the evolution of self-compatibility. The current potential for fruit set via autonomous self-pollination is high, thus populations may be predominantly inbred. However, mixed mating could be maintained if outcrossed pollen is prepotent or if post-fertilization mortality is higher among inbred offspring.

Key words: bromeliad, tropical montane cloud forest, plant breeding system, autonomous self-pollination, hummingbird pollination, reproductive assurance

INTRODUCTION

Vascular epiphyte species richness is greatest in intermediate elevation neotropical wet forests (Gentry 1982, Cardelús et al. 2006), where their reproductive biology has been examined at several locations. One of the most well-studied locations is the cloud forest of Monteverde, Costa Rica, where approximately 870 species, or 29% of the flora, are epiphytes (Haber 2000). At Monteverde the incidence of self-compatibility among epiphytic taxa greatly exceeds that found in any life form in the tropics (Bush & Beach 1995). All of the 31 epiphytic species tested are self-compatible, including 14 bromeliads (Bush & Beach 1995; Cascante-Marín et al. 2005, 2006; Bush unpubl. data). Many of the bromeliads studied in Monteverde are also capable of autonomous self-pollination, typically because the anthers and stigma are closely associated at anthesis (Bush & Beach 1995; Cascante-Marín et al. 2005, 2006). The underlying factors favoring autonomous self-fertilization, or autogamy, in Monteverde bromeliads are untested. However, one of the presumed benefits of autogamy is to provide reproductive assurance when cross-pollination is unpredictable (Levin 1971). A variety of factors potentially limit opportunities for outcrossing in epiphytic plants (Benzing 1990, Bush & Beach 1995). Most epiphytes are severely resource-limited and plant size is restricted (Benzing 1990). Consequently, epiphytes produce relatively few flowers (Ackerman 1986, Benzing 1990) and they may be less attractive to pollinators than terrestrial plants that present larger floral displays (Benzing 1990). The pollination systems of the majority of epiphytes are specialized (Madison 1977, Gentry & Dodson 1987), a trait frequently associated with outcrossing. However, a recent review suggests that autonomously self-pollinating taxa frequently have specialized pollinator relationships (Fenster & Martén-Rodríguez 2007). Perhaps visitation rates are reduced when pollination is limited to a narrow class of vectors, and autonomous selfing serves to ensure reproduction when cross-pollination is insufficient (Fenster & Martén-Rodríguez 2007). Since epiphyte populations are typically hyperdispersed rather than clumped (Ackerman 1986, Benzing 1990), epiphytes tend to be isolated from potential mates. A low density of flowering conspecifics, in addition to limited floral displays, should reduce visitation rates and thus strengthen the selection of autogamy in epiphytes with specialized pollinator relationships. Lastly, selfing may be advantageous in the ephemeral canopy habitat (Benzing 1990, Bush & Beach 1995, Hietz et al. 2006), where survival to reproduction is uncertain due to exfoliating bark, branch falls, and host tree falls (Ackerman 1986, Hietz et al. 2002). Whatever the selective advantage, self-fertilization is important for many bromeliads in Monteverde, despite conditions that favor high species richness.