

Revision of the *Aechmea multiflora* complex (Bromeliaceae)

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A taxonomic revision of the *Aechmea multiflora* complex (Bromeliaceae) is presented. The complex currently comprises four species belonging to the subgenus *Chevaliera*. In this study, we document morphological variation in herbarium and living plants in order to improve the delimitation of species in the genus *Aechmea*. Three species were recognized: *A. multiflora*, *A. depressa*, and *A. saxicola*. We propose *A. hostilis* to be a synonym of *A. saxicola*. These species are restricted to the eastern coast of Brazil, and are known from only a few herbarium collections. The conservation status of these species is ‘vulnerable’ according to IUCN criteria. We present a key, descriptions, typification, drawings, photographs and a map of distribution. © 2003 The Linnean Society of London, *Botanical Journal of the Linnean Society*, 2003, 143, 189–196.

ADDITIONAL KEYWORDS: Brazil – Bromelioideae – *Chevaliera* – conservation – morphology – taxonomy.

INTRODUCTION

Systematics in the Bromeliaceae is controversial and problematic. This is particularly true for the subfamily Bromelioideae in which the genus *Aechmea* Ruiz & Pav. is placed. The most recent monographic treatment of the Bromelioideae is that of Smith & Downs (1979), in which they recognized 172 species of *Aechmea*, dividing them into eight artificial subgenera. Since 1979, numerous new species and generic-level taxonomic changes have been proposed in the Bromelioideae, many involving the genus *Aechmea* (Read, 1984; Smith & Spencer, 1992; Luther & Sieff, 1994, 1997; Read & Baensch, 1994; Luther, 2001). The most controversial was the elevation of all *Aechmea* subgenera to generic rank (Smith & Kress, 1989, 1990), an action that has not been widely adopted (e.g. Luther & Sieff, 1994). These problems are almost always magnified by an incomplete knowledge of critical diagnostic morphological features for many taxa. The taxonomic problems within *Aechmea* require detailed scrutiny

before the proposal of new treatments (Wendt, 1997).

This paper attempts to provide a sound delimitation of the closely related species which constitute the *A. multiflora* complex: *A. multiflora* L. B. Sm., *A. depressa* L. B. Sm., *A. saxicola* L. B. Sm., and *A. hostilis* E. Pereira. These species belong to the subgenus *Chevaliera* (Gaudich. ex Beer) Baker (*sensu* Smith & Downs, 1979) which comprises c. 21 robust tank bromeliad species, bearing hard serrate leaves over 1 m long, with large strobiliform inflorescences commonly armed with pungent bracts. They frequently grow as epiphytes. Due to difficulties in accessing, collecting, drying, and handling material from these species, the number of available herbarium specimens is small. Smith & Downs (1979) cite the type plus five specimens for *A. multiflora* and basically the type collections for the other three taxa. Smith (1937, 1941, 1950) described three species recognized in this complex but made no comparison or comments about the affinities between them. Smith (1937) described *A. multiflora*, and suggested affinities between the Amazonian *A. fernandae* (E. Morren) Baker and Amazonian *A. rubiginosa* Mez, both of the subgenus *Chevaliera*. Later, Smith (1941) described

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A. depressa and considered it a new species close to *A. fernandae*, making no reference to *A. multiflora*, which was unusual as *A. multiflora* and *A. depressa* occur in the state of Bahia. When Smith (1950) described *A. saxicola*, he proposed that it resembled species of the subgenus *Chevaliera sensu* Mez (1896; 1935), but differed from other members of the subgenus in having serrate floral bracts. Instead, he suggested that *A. saxicola* had affinities with *A. pectinata* Baker, which has serrate bracts. *Aechmea pectinata* belongs to subgenus *Pothuava* (Baker) Baker, and is very distinct from *A. saxicola*. Smith was mistaken in completely ignoring the serrate floral bracts of both *A. depressa* and *A. multiflora*. Although Smith & Downs (1979) provided keys, descriptions and illustrations for the four species, species delimitation within *A. multiflora* complex remains problematic, and can result in mistakes in identifying specimens.

In spite of the scarcity of herbarium specimens, several photographs of the large and interesting inflorescences of these species have appeared (with conflicting identifications) in journals and books dedicated to the Bromeliaceae (e.g. Kent, 1982; Leme & Marigo, 1993; Leme, 1997, 1998). The purpose of this study was to re-assess the accepted taxa in the *A. multiflora* complex and identify morphological characters that delimit them.

MATERIAL AND METHODS

Morphological variation within the complex was assessed by examination of plants in cultivation, plants collected in the field, and preserved material from the following herbaria: ALCB, CEPEC, GUA, HUEFS, MBM, HB, R, RB, and RFA (abbreviations according to Holmgren, Holmgren & Barnett, 1990); and the herbaria of Universidade Federal do Espírito Santo (abbreviated as VIES). Type specimens or photograph-types from HB, K, R and US have also been

examined. Our observations were based upon careful reading of the original description and examination of type or photograph-types. Floral parts of herbarium specimens were softened in boiling water prior to dissection followed by light microscope examination and drawing. Data on geographical distribution, habit, habitat and colours were compiled from herbarium sheets and additional observations made from cultivated specimens. The citation of the collections examined was organized as follows: (1) Brazilian States listed geographically from north to south; (2) municipalities within States listed alphabetically; and (3) sheets within municipalities listed according to date.

DESCRIPTIONS

AECHMEA SAXICOLA (FIGS 1A–C, 2–4, 8A)

Aechmea saxicola L. B. Sm., Arq. Bot. São Paulo II. 2: 118, tab 48 (1950). Type: *Foster & Foster 164*, Cachoeira de Itapemirim, Espírito Santo, Brazil, 7.vii.1939 (US! Holotype and K! phototype; GH isotype; R isotype not localized).

= *Chevaliera saxicola* (L. B. Sm.) L. B. Sm. & W. J. Kress, *Phytologia* 66 (1): 78 (1989). H. E. Luther & E. Sieff, *Selbyana* 15 (1): 65 (1994); *pro syn.*

= *Aechmea hostilis* E. Pereira, *Bradea* 1 (25): 227, tab. 3 A (1972). Type: *Seidel 625*, Domingos Martins, Espírito Santo, Brazil, 21.iii.1972 (HB! holotype); *syn. nov.*

= *Chevaliera hostilis* (E. Pereira) L. B. Sm. & W. J. Kress, *Phytologia* 66 (1): 78 (1989). H. E. Luther & E. Sieff, *Selbyana* 15 (1): 65 (1994); *pro syn.* *Aechmea hostilis* E. Pereira.

Plants flowering to a height of c. 100 cm. LEAF BLADES green, linear, 60–217 × 7–10 cm, apex pungent 10 mm long, laxly serrate with dark spines up to 4 mm long, some of them retrorse. LEAF SHEATHS castaneous or purplish, elliptic, 13–35 × 11–14 cm. SCAPE

KEY TO THE SPECIES

- 1 Petals 25–35 mm long, connate in the transition between limb and claw (Fig. 1C), exceeding the length of the sepals (12–30 mm). Floral bracts ovate with long-attenuate pungent apices, margin c. 2/3 minutely serrulate (Fig. 1A). Inflorescence compressed early in development, but elongating 2–3 times later in development (Figs 2,3). Plants from Espírito Santo and Rio de Janeiro States *A. saxicola*
- 1 Petals 17–21 mm long, free, and not exceeding the length of the sepals (15–29 mm). Floral bracts oblong with obtuse-acuminate, pungent apices, margin c. 1/3 serrate (Fig. 1D, G) 2
- 2 Inflorescence compressed early in development, but elongating 5–6 times during development (Fig. 5). Sepals strongly asymmetrical, ending in a stout spine of 2–4 mm. Plants from Bahia and Sergipe States *A. multiflora*
- 2 Inflorescence compressed and not elongating during development. Sepals slightly asymmetric, ending in a soft spine of 1 mm. Endemic to Bahia State. *A. depressa*

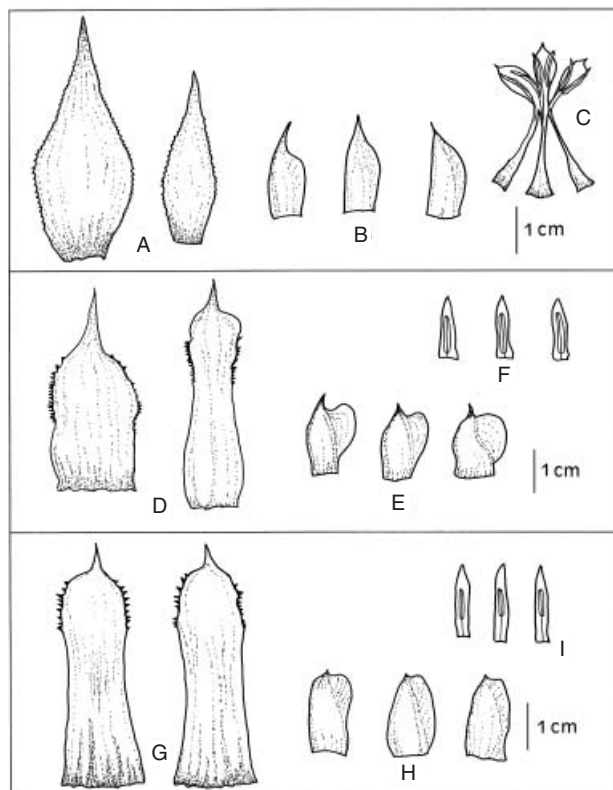


Figure 1. A–C, *Aechmea saxicola* (Wendt 286 RB). D–F, *Aechmea multiflora* (Canela 1 RB, RFA). G–I, *Aechmea depressa* (Jardim 612 CEPEC). A, D and G, floral bracts. B, E and H, sepals. C, F and I, petals.

stout, 13–57 cm long. scape bracts imbricate, broadly ovate, apex pungent 10 mm long, serrate. INFLORESCENCE strobiliform, 7–17 × 8–12 cm long, compressed early in development and elongating 2–3 times during development. FLORAL BRACTS red or greenish at the apices, ovate and slightly concave, 36–55 × 10–22 mm, long-attenuate with pungent apices 5–8 mm long, margin *c.* 2/3 minutely serrulate. FLOWERS compressed against each other, sessile, *c.* 40 mm long. SEPALs fused for 3 mm, yellow-greenish, lanceolate, slightly asymmetric, two of them carinate, 12–30 × 7–8 mm, apex acute ending in a spine of 3–4 mm long. PETALS fused in the transition between claw and limb, white-yellowish, become dark after anthesis, spatulate, 25–35 × 5 mm, exceeding the calyx length. STAMENS six, filaments adnate to the petals. OVARY inferior, compressed, laterally alate-carinate, epigynous tube *c.* 7–10 mm long. OVULES many, caudate, smaller than 1 mm long. SEEDS fusiform, *c.* 3 mm long.

Distribution and habitat

Aechmea saxicola occurs in Espírito Santo and Rio de Janeiro (Fig. 9). It grows as an epiphyte or terrestri-

ally in the Atlantic rainforest and on the sandy coastal plains ('restingas').

Collections examined

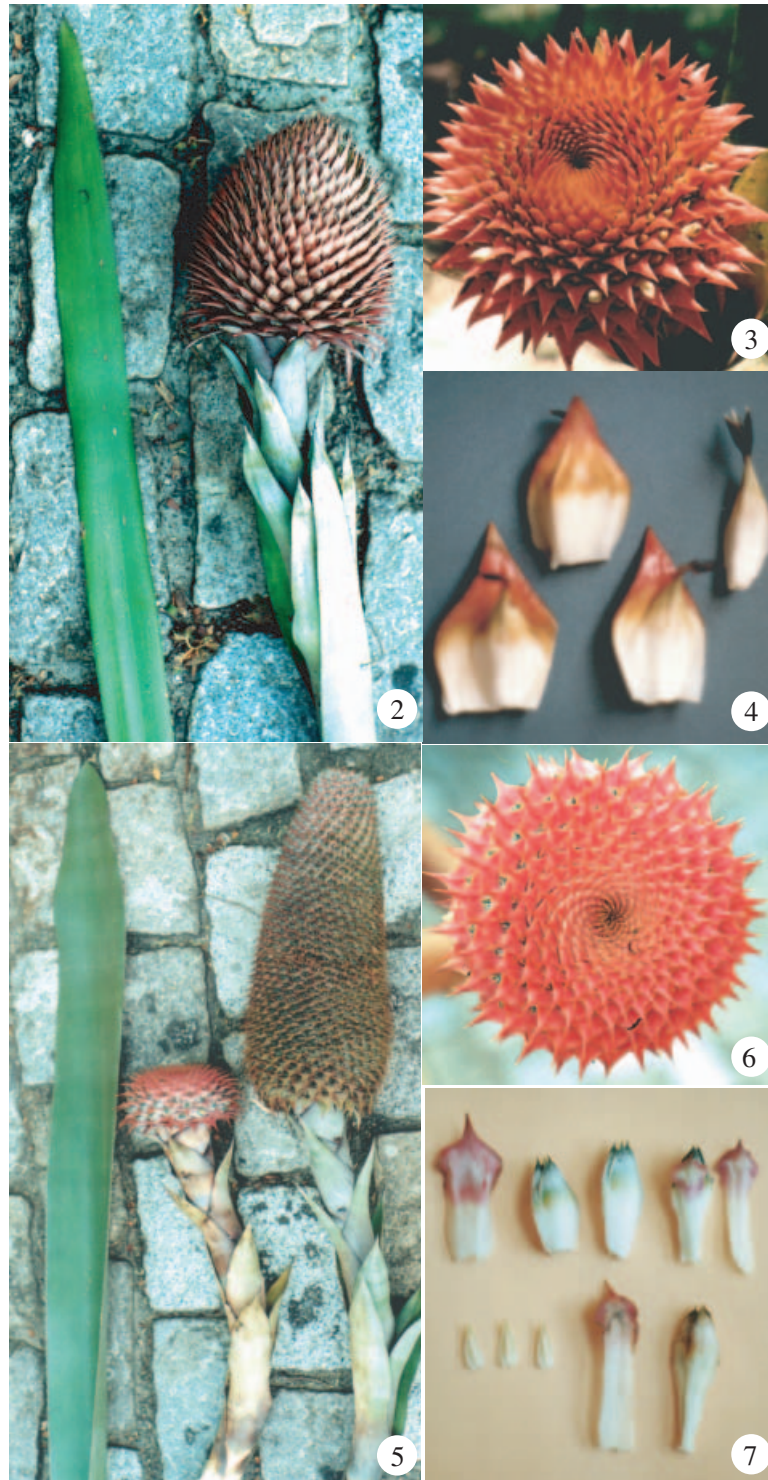
BRAZIL: without specific locality, in cultivation on Sítio Roberto Burle Marx at Rio de Janeiro, viii.1997, Sampaio 05 (RB); 6.iii.1998, Prado 1, Canela & Wendt (RB, RFA). ESPÍRITO SANTO: Cachoeira de Itapemirim, 7.vii.1939, Foster & Foster 164 (US, K); Colatina, Monte Claro, 20.vii.1939, Foster & Foster 224 (R); Comboios, Aracruz, 27.vii.1992, Pereira 3610 & Gomes (VIES); Domingos Martins, 21.iii.1972, Seidel 625 (HB); Itapemirim, 7.vii.1939, Foster & Foster 153 (R); Presidente Kennedy, Praia das Neves, 29.iv.1998, Gomes 2392 (VIES); Santa Teresa, Estação Ecológica de Santa Lúcia, 29.iv.2001, Faria 27 (RFA). RIO DE JANEIRO: Macaé, Restinga de Cabiúnas, 11.i.1995, Araújo 6515 (GUA); Nova Friburgo, Santa Luzia, 30.vii.2000, Quinet 428 (RFA); 18.viii.2000, Quinet 484 (RFA); Silva Jardim, Reserva Biológica de Poço das Antas, 14.xii.1993, Wendt 286 (RB); vii.1997, Wendt 327 (RB).

AECHMEA MULTIFLORA (FIGS 1D–F, 5–7, 8C)

Aechmea multiflora L. B. Sm., Contr. Gray Herb. 117: 4, pl. 1, figs 1–3 (1937). Type: Curran 297, Rio Grongogy (Gongogi), Bahia, Brazil, 1.x–30.xi.1915 (US! Holotype and K! phototype).

= *Chevaliera multiflora* (L. B. Sm.) L. B. Sm. & W. J. Kress, Phytologia 66 (1): 78 (1989). H. E. Luther & E. Sieff, Selbyana 15 (1): 65 (1994); *pro syn.*

Plants flowering to a height of *c.* 100 cm. LEAF BLADES green, linear, 85–231 × 11–14 cm, apex pungent 10 mm long, densely serrate with dark spines up to 5 mm long, some of them retrorse. LEAF SHEATHS adaxially nigrescent and abaxially white-greenish, elliptic, 38–40 × 15–19 cm long. SCAPE stout, 55 cm long, scape bracts imbricate, ovate, apex pungent 10 mm long, densely serrate. INFLORESCENCE strobiliform, 5–29 × 9–11 cm long (up to *c.* 36 × 16 cm in fresh material), compressed early in development and elongating 5–6 times during development. Floral bracts red at the apices, oblong and slightly concave, 40–58 × 6–30 mm, obtuse-acuminate in pungent apices 6–13 mm long, margin *c.* 1/3 serrate. FLOWERS compressed against each other, sessile, *c.* 40 mm long. SEPALs fused for 3 mm, castaneous-greenish at the apices, ovate, strongly asymmetric, two of them carinate, 15–29 × 9–11 mm, apex obtuse ending in a stout spine of 2–4 mm long. PETALS free, white-yellowish, lanceolate, 17–20 × 5 mm, not exceeding the calyx length. STAMENS six, free. OVARY inferior, compressed, laterally alate-carinate, epigynous tube *c.* 5 mm long. OVULES many, caudate, smaller than 1 mm long. SEEDS fusiform, *c.* 3 mm long.



Figures 2–7. Species of *Aechmea* in cultivation. Figs 2–4. *Aechmea saxicola* (Prado 1 RB, RFA). Figs 5–7. *Aechmea multiflora* (Canela 1 RB, RFA). Fig. 2. Leaf and mature inflorescence. Figs 3, 6. Upper view of young inflorescences. Figs 4, 7. Details of flowers, and flowers bracts. Fig. 5. Leaf, young and mature inflorescence.

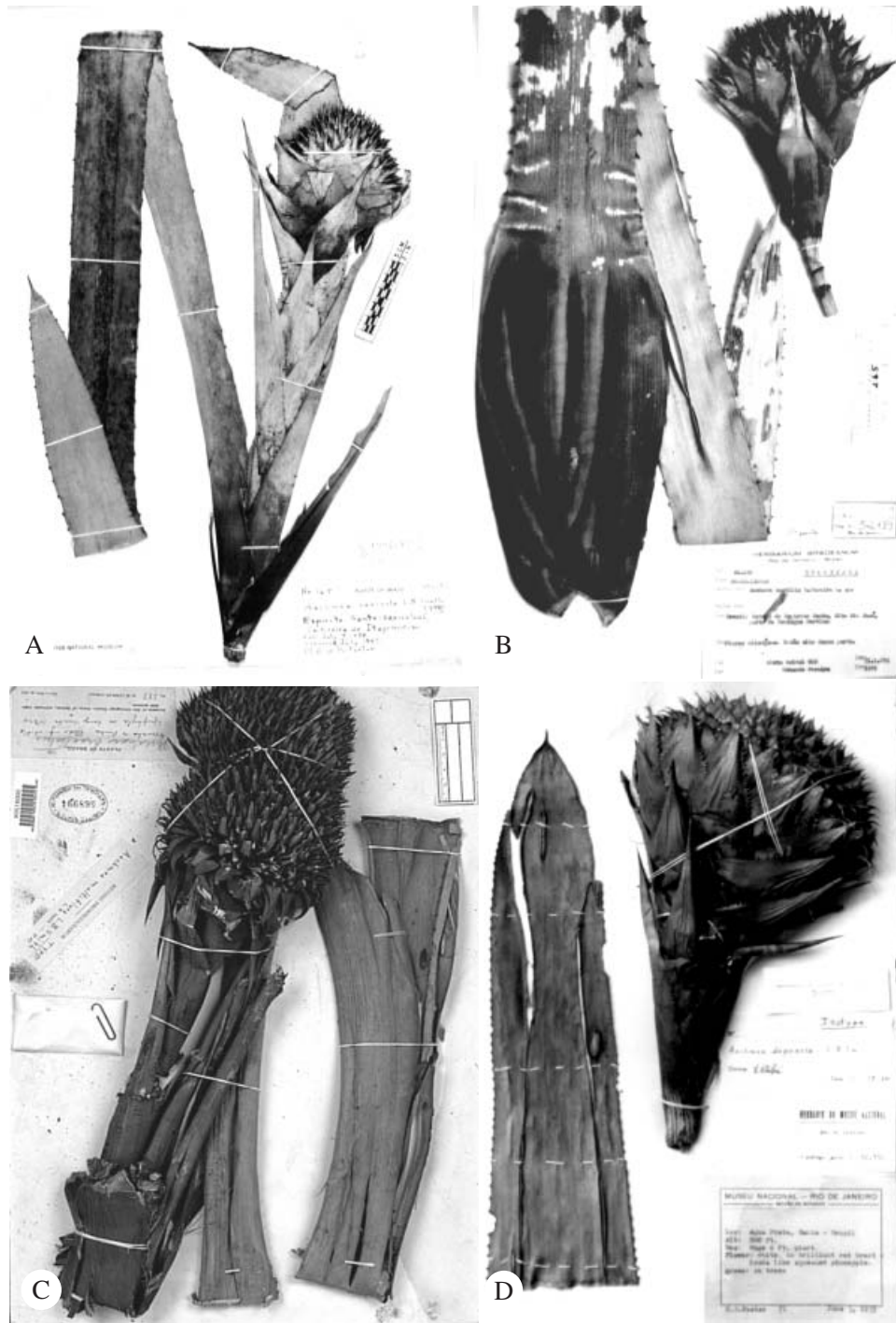


Figure 8. Type specimens. A, *Aechmea saxicola* (Foster & Foster 164 K). B, *Aechmea hostilis* (Seidel 625 HB). C, *Aechmea multiflora* (Curran 297 K). D, *Aechmea depressa* (Foster 71 R).

Distribution and habitat

Aechmea multiflora occurs in Sergipe and Bahia states. It grows epiphytically or terrestrially in tropical mesophytic forest and mangrove swamps (Fig. 9). Smith & Downs (1979: 1942) indicated this species as also occurring in Espírito Santo. How-

ever, our examination of collections did not confirm this.

Collections examined

BRAZIL: without specific locality, in cultivation on Sítio Roberto Burle Marx at Rio de Janeiro, 6.iii.1998,

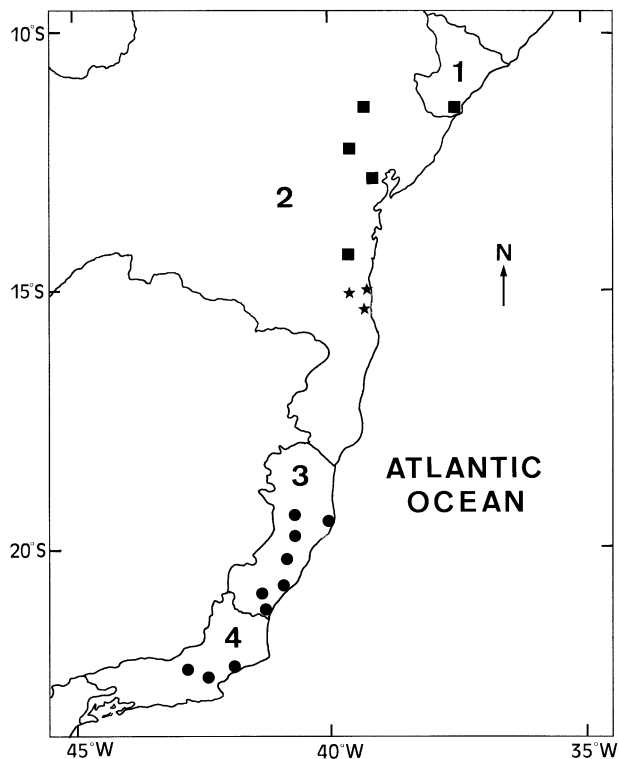


Figure 9. Geographic distribution of (●) *Aechmea saxicola*, (★) *Aechmea depressa* and (■) *Aechmea multiflora* on the eastern coast of Brazil. One symbol does not always correspond to one herbarium specimen, but may represent more than one. 1, Sergipe. 2, Bahia. 3, Espírito Santo. 4, Rio de Janeiro.

Canela 1, Prado & Wendt (RB, RFA). SERGIPE: Santa Luzia do Itanhi, 27.xi.1993, *Amorim 1480* (CEPEC). BAHIA: Rio Gongogi, 1.x–30.xi.1915, *Curran 297* (US, K); Cachoeira, Morro Belo, Vale dos rios Paraguaçu e Jacuípe, 13.viii.1981, *Grupo Pedra do Cavallo 496 A* (ALCB); Ipirá, Fazenda do Recreio, Estrada do Feijão, 4.x.1986, *Queiroz 957* (HUEFS, MBM); Valente, Santa Bárbara, 29.xiii.1992, *Queiroz 3018, Serra & Sampaio* (HUEFS, MBM).

AECHMEA DEPRESSA (FIGS 1G–I, 8D)

Aechmea depressa L. B. Sm., *Arq. Bot. São Paulo* I. 1: 54, tab. 66 (1941). Type: *Foster 71*, Água Preta (Uruçuca), Bahia, Brazil, 3.vi.1939 (GH holotype; R! isotype).

= *Chevaliera depressa* (L. B. Sm.) L. B. Sm. & W. J. Kress, *Phytologia* 66 (1): 78 (1989). H. E. Luther & E. Sieff, *Selbyana* 15 (1): 65 (1994); *pro syn.*

Plants flowering to a height of c. 100 cm. LEAF BLADES green, linear, 81–230 × 11–13 cm, apex pungent 5–10 mm long, densely serrate upper and laxly serrate toward base with dark spines up to 4 mm long,

some of them retrorse. LEAF SHEATHS white-greenish, with dark-green spotted, only a little wider than blades. SCAPE stout, c. 12–25 cm long. Scape bracts imbricate, broadly ovate, apex pungent 10 mm long, densely serrate. INFLORESCENCE strobiliform, 11–12 × 14–22 cm, compressed and not growing in length later in development. FLORAL BRACTS reddish at the apices, oblong and slightly concave, 51–57 × 13–20 mm, obtuse-acuminate in pungent apices 5–6 mm long, margin c. 1/3 serrate. FLOWERS compressed against each other, sessile, c. 45 mm long. SEPALS fused for 3 mm, green, ovate, slightly asymmetric, carinate, 17–20 × 8–9 mm, apex obtuse, ending in a soft spine 1 mm long. PETALS free, white, lanceolate, 17–21 × 3–5 mm, not exceeding calyx length. STAMENS six, free. OVARY inferior, compressed, laterally alate-carinate, epigynous tube c. 6 mm long. OVULES many, caudate, c. 1 mm long. SEEDS fusiform, c. 2 mm long.

Distribution and habitat

Aechmea depressa is known from a single restricted location in the State of Bahia. It grows as an epiphyte in the coastal rain forests of southern Bahia (Fig. 9).

Collections examined

BRAZIL. BAHIA: Ilhéus, Mata da Esperança, 16.ii.1995, *Jardim 612* (CEPEC); Una, Reserva Biológica do Mico-Leão, 12.ii.1997, *Carvalho 6320* (CEPEC); Ecoparque Entorno da Reserva Biológica de Una, 22.iv.1998, *Fontoura 407* (CEPEC); Uruçuca, Água Preta, 3.vi.1939, *Foster 71* (R).

TAXONOMIC DISCUSSION

The *Aechmea multiflora* complex includes *A. multiflora*, *A. depressa* and *A. saxicola*, all very similar in their morphology. Identification of herbarium specimens was occasionally incorrect, as were some of the published photographs in the literature because of this similarity in morphology. Most herbarium specimens that we examined were identified as *A. multiflora*. These misidentifications occurred because most collections followed the interpretation of Smith & Downs (1979: 1942)

The affinity between *A. saxicola* and *A. pectinata* proposed by Smith (1950) probably contributed to a misinterpretation of *A. hostilis* when described by Pereira (1972). Pereira commented that *A. hostilis* was closely related to *A. saxicola* except that it had floral bracts that were longer than the sepals. An accurate reading of Smith (1950) shows that *A. pectinata* is the taxon with shorter floral bracts than sepals and not *A. saxicola* as interpreted by Pereira (1972). We compared the type material of *A. saxicola* and *A. hostilis* (Fig. 8A, B). We concluded that both species have similarly proportioned floral bracts relative to

their sepals. The original descriptions of *A. saxicola* and *A. hostilis* also pointed out one difference concerning ovule morphology. Smith (1950) described ovules as being caudate in *A. saxicola*; Pereira (1972) stated that ovules were not caudate in *A. hostilis*. In living plants of *A. saxicola*, we observed that ovules showed a hyaline caudate appendage. However, this delicate appendage is very difficult to observe in rehydrated herbarium material. Seeds that develop from these ovules are fusiform, or less frequently unciform in shape, but do not have appendages at maturity. The same pattern was observed in type material of *A. hostilis*. [We could not get permission to examine ovules or seeds of the type of *A. saxicola* deposited in the US, and the isotype cited by Smith & Downs (1979) at R was not located, and has probably never been part of that collection.] During seed development, appendages are lost; thus, depending upon the stage of floral development, and the condition of preservation, different interpretations of this character are possible. Irrespective of these problems, we concluded that both *A. saxicola* and *A. hostilis* have caudate ovules. We also concluded that *A. saxicola* and *A. hostilis* are the same species. This observation is supported by the fact that both Smith (1950) and Pereira (1972) mention the concrescence of the petals between the transition of the claw and limb. This peculiar character, uncommon in *Aechmea*, is easily observed in fresh material but more difficult to observe in dried flowers. Petal concrescence can be consistently used to differentiate *A. saxicola* from *A. multiflora* and *A. depressa*, both of which have free petals.

Several publications have presented beautiful photographs of flowering individuals of *A. saxicola*. In Kent (1982: 145, cover) this species was wrongly identified as *A. sphaerocephala* Baker. In Leme & Marigo (1993: 52) it was identified as *A. hostilis* (considered here to be a synonym of *A. saxicola*). In Leme (1997: 40, cover) it was correctly identified as *A. saxicola*, while in Leme (1998: cover) it was identified as *A. multiflora*. In all of the published photographs we have seen, it is easy to observe that the petals exceed the length of the sepals. This latter character easily distinguishes *A. saxicola* from *A. multiflora* and *A. depressa*.

Aechmea multiflora and *A. depressa* are very similar but can be differentiated based on the size of their inflorescences at maturity. The inflorescence of *A. multiflora* expands markedly at maturity (Fig. 5; observed on cultivated plant at Sítio Roberto Burle Marx, Rio de Janeiro) while *A. depressa* remains compressed (T. Fontoura, pers. comm.). Both species occur in Bahia State. Depending upon the developmental stage of their inflorescence, it may be difficult to correctly identify them using only the length of their

inflorescences. However, close examination of the sepals of *A. multiflora* will show them to be more asymmetric than in *A. depressa*. The flowers of *A. multiflora* also have a stout spine 2–4 mm long at the sepal apex, whereas *A. depressa* has sepals that have a soft spine 1 mm long at their apex.

DISTRIBUTION AND CONSERVATION

Aechmea saxicola, *A. multiflora*, and *A. depressa* are geographically restricted to the eastern coast of Brazil (Atlantic Rain Forest Biome). These taxa occur in only a few restricted, generally unprotected locations. Their poor representation in herbarium collections may be due to difficulties in handling but is also, undoubtedly, due to their rarity. Normally, herbarium specimens provide no details concerning the abundance of individuals, thus providing little information about population size and the need for conservation. We observed a very low frequency of *A. saxicola* in two field localities: Macaé and Silva Jardim. We decided to classify these three species as 'vulnerable', a category that includes taxa with small populations that could be at risk (IUCN, 1994). Our interpretation is based on a paucity of known collections coupled with the fact that these taxa are a part of the Atlantic Rain Forest, one of the most endangered biomes on Earth (Myers *et al.*, 2000).

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