Check-list of Bromeliaceae from Mato Grosso do Sul, Brazil

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ABSTRACT – A checklist of 11 genera and 41 species of Bromeliaceae occurring in the state of Mato Grosso do Sul (MS) is presented. Of the total number of species, five are endemic and belong to the genera Dyckia and Tillandsia. The subfamily Pitcairnioideae is the richest in number of genera and species, including taxa that are rare in Brazil (Deuterocohnia and Fosterella). Tillandsioideae is the richest subfamily in species number plus one infraspecific taxon; however, it is only represented by Tillandsia, and most species are widely distributed all over Brazil and/or nearby countries. Bromelhoideae, a subfamily characteristic of the Atlantic rainforest is less represented. This checklist updates the number of species in Mato Grosso do Sul, when compared to the Official Brazilian Plant Checklist.

Keywords: bromeliads, catalogue, monocots, Poales, savanna

INTRODUCTION

Bromeliaceae (58 genera, 3248 species) are almost exclusively Neotropical (Smith & Downs 1974, Luther 2010) and currently divided into eight subfamilies (Brochiniioideae, Lindmanioideae, Tillandsioideae, Hechtioideae, Navioideae, Pitcairnioideae, Puyoideae and Bromelioideae) that are mainly characterized by the morphology of the flowers, fruit, seeds, and molecular data (Givnish et al. 2007, 2011).

The diversity of Bromeliaceae in Brazil is highest in humid areas of the Atlantic rainforest along eastern Brazil, with a decrease in species richness observed toward the drier inland territory (Reitz 1983, Versieux & Wendt 2006, 2007, Martinelli et al. 2008, Versieux et al. 2012). Nevertheless, drier areas may harbor endemic and xerophytic species, the systematics, taxonomy, and conservation of which have not yet received much attention (e.g., Miranda 2001, Braun & Pereira 2009, Leme et al. 2012, Paggi et al. 2015).

The state of Mato Grosso do Sul (MS) in central-western Brazil is covered by three different biomes: Cerrado (savanna), the Pantanal wetland (including part of the Chaco) and part of the Atlantic rainforest (IBGE 2004). The Cerrado savanna has a mosaic of physiognomies. It is severely threatened, and it is considered to be one of the areas of heaviest human impact in the state of MS (Cavalcanti & Joly 2002). In all these biomes, bromeliads occur and may be threatened due to habitat loss.

As a result of the collections that have become available recently, new Bromeliaceae taxa are being described or rediscovered from MS (e.g., Braun & Pereira 2008, 2009, Leme et al. 2012, Versieux et al. 2013, Paggi et al. 2015), but the knowledge of this family in MS is still fragmentary and is affected by the paucity of collections available in herbaria. The aim of this study is to provide a preliminary checklist for that state, which may help future studies focused on the taxonomy and conservation of this family in central-western Brazil.
MATERIAL AND METHODS

Data to establish the occurrence of Bromeliaceae taxa in the state of MS comes from three main sources: (1) herbarium collections which were examined by the authors (MBM, UEC, R, RB, COR acronyms according to Holmgren et al. 1990), (2) literature (checklists, floras, revisions of genera, descriptions of new taxa), and (3) online databases and virtual herbaria catalogues (HB, NY, K, US). The nomenclature used follows Govaerts et al. (2005). New species that have not been validly published or taxa that could not be identified, and thus demand revisions, are listed as numbered morphospecies. For each taxon one herbarium specimen is cited, the predominant growth style (or habit) annotated in the specimens labels (epiphyte, terrestrial, rupicolous), as well as an indication of the vegetation type where the species is commonly found (savanna = Brazilian Cerrado, including different physiognomies and riparian forests; seasonal dry forest; rainforest). The acronyms of herbaria highlighted by an asterisk indicate that the record of the taxon from MS was obtained from the literature or from databases and that the specimen was not examined by the authors.

RESULTS AND DISCUSSION

In the Brazilian official plant checklist, 11 genera, 30 species, and two varieties are included for the state of MS (Forzza et al. 2014). In the present work we list 11 genera, 40 species, and 41 taxa (including one variety) for the Flora of Mato Grosso do Sul (Table 1). From the total of species listed here, five are endemic to MS. The majority of the species occurring in MS can also be found in neighboring countries, such as Bolivia, Paraguay, and Argentina (Table 1). The subfamily Pitcairnioideae is the richest in species (5 genera / 18 spp.), followed by Tillandsioideae (1 genus / 12 spp.), and by Bromelioideae (5 genera / 10 spp.).

The more open vegetation of the savanna and seasonal dry forests, together with the high degree of outcropping (especially limestone and sandstone), are probably more conducive to the predominant terrestrial or lithophytic habit observed here for most of the Bromelioidae and Pitcairnioideae taxa. The genus Tillandsia (Tillandsioideae subfamily) is an exception to this pattern as most species are epiphytes. Tillandsia species are called “air plants” because they have several adaptations to endure water stress (e.g., CAM photosynthesis, dense indumentum, specialized trichomes) and thus can grow in most kind of habitats, including deserts (Benzing 2000a). In MS, Tillandsia is the richest genus and one new species was found there recently (Versieux et al. 2013). It is interesting, however, that both T. usneoides (L.) L. and T. recurvata (L.) L., the two best distributed bromeliad species across the entire Americas, were not found in this survey. Most of the species of Tillandsia found in MS are broadly distributed in Brazil and nearby countries (Table 1). Only Tillandsia buchloehii and T. bonita are more restricted, the first to the area of Porto Murtinho and nearby iselbergs in Paraguay, and the latter is endemic to the Serra da Bodoquena (Till 1996, Versieux et al. 2013).

The subfamilies Bromeliaceae and Pitcairnioideae call attention due to their richness of genera (five in total). Pitcairnioideae is believed to have undergone a strong lineage diversification in Central Andes, along the region that now corresponds to Bolivia (Givnish et al. 2011). The proximity between MS and Bolivia may explain the occurrence of particular genera such as Deuterocohnia and Fosterella, which have restricted distribution in Brazil. Deuterocohnia is represented in Brazil only by D. meziana, which is confined to MS, Mato Grosso, southeastern Bolivia and Paraguay (Smith & Downs 1974, Forzza et al. 2014). Currently, 18 species are recognized within this genus (Luther 2010), all of them are perennial lithophytes or terrestrials that can tolerate large temperature shifts, including frosts (Benzing 2000a) and also extended dry periods. The distribution of most species is restricted to the dry areas of southern South America, mainly from southern Bolivia to northern Argentina, but it also reaches arid coastal habitats in Peru (Rundel & Dillon 1998) or isolated coastal desert in Chile (Zikza et al. 2009). Some species of Deuterocohnia present perennial inflorescences, flowering repeatedly for 6-8 years through the producing of new spikes from lateral buds (Benzing 2000b), and several of them show a conspicuous clonal growth, thus being called cushion-plants (Givnish et al. 2011). Fosterella genus is another interesting Pitcairnioideae, which is distributed across central South America, with a center of diversity in arid and semi-humid habitats of the northeastern Andean slopes of Bolivia (Rex et al. 2009). In Brazil, Fosterella is represented by three species (Forzza et al. 2014) and F. hastschbachii is a rupicolous taxon that grows on shaded sandstones in MS as well as in neighboring Mato Grosso state. It has lax inflorescences and delicate flowers. Regarding the Bromeliaceae genera, all with baccate fruits, are broadly distributed in Brazilian territory. Ananas, Bromelia and Pseudoananas taxa occurring in MS are all terrestrial xerophytic species.

Due to its geographic location the bromeliads that occur in MS may also grow in Argentina, Paraguay, and Bolivia. Old specimens from the “Comissão Rondon” and “Expedição Científica Roosevelt-Rondon” are deposited in Museu Nacional (Herbarium R) for Dyckia leptostachya, a taxon that has a long synonymy including other species described from neighboring countries. Dyckia is a large genus, with at least 120 species in Brazil (Forzza et al. 2014) that are adapted to xeric habitats. It is extremely difficult to study Dyckia based only on herbarium material. Collections usually are incomplete, lacking the rosette or containing only branches of the inflorescence, and indumentum and size of the rosettes may present large variation (Versieux 2012). Dyckia, like many other low-dispersed Pitcairnioideae has a high degree of endemic species (Versieux & Wendt 2006, 2007). During our inventory we saw many names in the herbaria that are
Table 1. Bromeliaceae taxa occurring in Mato Grosso do Sul, Brazil, followed by a herbarium specimen, growth style (habit), habitat and overall geographic distribution. Abbreviations used: Epi = Epiphyte, Rup. = Rupicolous, Ter. = Terricolous. Habitat: RF = Rainforest, Sav = Savanna (Cerrado sensu lato), SDF = Seasonal Dry Forest.

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Voucher (Herb.)</th>
<th>Growth</th>
<th>Habitat</th>
<th>Geographical distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aechmea bromeliifolia var. albo-braeexusata Philcox</td>
<td>Wendt et al. 261 (COR)</td>
<td>Epi, Ter</td>
<td>Sav</td>
<td>Argentina, Paraguay, central, south and south-eastern Brazil (Faria et al. 2010)</td>
</tr>
<tr>
<td>A. distichantha Lem.</td>
<td>Pott et al. 4412 (MBM)</td>
<td>Ter</td>
<td>Sav</td>
<td>Argentina, Paraguay, Uruguay, south and south-eastern Brazil and MS (Smith &amp; Downs 1979)</td>
</tr>
<tr>
<td>Ananas ananassoides (Baker) L.B.Sm.</td>
<td>Guimarães 1176 (RB)</td>
<td>Ter</td>
<td>Sav</td>
<td>Argentina, Brazil, Paraguay (Smith &amp; Downs 1979)</td>
</tr>
<tr>
<td>Billbergia kuhlmannii L.B.Sm.</td>
<td>Damasceno-Júnior et al. 3845 (COR)</td>
<td>Epi</td>
<td>SDF</td>
<td>Brazil (MS, MT) (Forzza et al. 2014)</td>
</tr>
<tr>
<td>B. nutans H.Wendl. ex Regel</td>
<td>Garcia 14103 (UEC)</td>
<td>Epi</td>
<td>Sav, SDF</td>
<td>Argentina, Brazil, Paraguay, Uruguay (Smith &amp; Downs 1979)</td>
</tr>
<tr>
<td>Bromelia balansae Mez</td>
<td>Damasceno-Júnior et al. 3089 (COR)</td>
<td>Ter</td>
<td>Sav, SDF</td>
<td>Argentina, Bolivia, Brazil, Colombia, Paraguay (Smith &amp; Downs 1979)</td>
</tr>
<tr>
<td>B. hieronymii Mez</td>
<td>Ishii et al. 781 (COR)</td>
<td>Ter</td>
<td>SDF</td>
<td>Argentina, Bolivia, Paraguay (Smith &amp; Downs 1979), Brazil (MS) (Forzza et al. 2014)</td>
</tr>
<tr>
<td>B. interior L.B.Sm.</td>
<td>Oliveira 10 (MBM)</td>
<td>Ter</td>
<td>Sav</td>
<td>Brazil (DF, GO, MA, MG, MS, MT, RO, SP) (Smith &amp; Downs 1979)</td>
</tr>
<tr>
<td>B. serra Griseb.</td>
<td>Wendt et al. 266 (MBM)</td>
<td>Ter</td>
<td>Sav</td>
<td>Argentina, Brazil, Bolivia, Paraguay, (Smith &amp; Downs 1979)</td>
</tr>
<tr>
<td>Deuterocohnia meziana Kuntze ex Mez</td>
<td>Vieira et al. 1419 (RB)</td>
<td>Ter, Rup</td>
<td>Sav</td>
<td>Bolivia, Brazil (MS, MT), Paraguay (Forzza et al. 2014)</td>
</tr>
<tr>
<td>Dyckia cosimensis L.B.Sm. &amp; Reitz</td>
<td>Reitz 7365 (HBR*)</td>
<td>Ter</td>
<td>?</td>
<td>Brazil (MT, MS) (Smith &amp; Downs 1979, Forzza et al. 2014)</td>
</tr>
<tr>
<td>D. duckei L.B.Sm.</td>
<td>Leme 3458 (HB*)</td>
<td>Ter, Rup</td>
<td>Sav</td>
<td>Brazil (MA, MS, PA) (Forzza et al. 2014)</td>
</tr>
<tr>
<td>D. excelsa Leme</td>
<td>Ishii et al. 785 (COR)</td>
<td>Ter, Rup</td>
<td>SDF</td>
<td>Brazil (MS, MT) (Forzza et al. 2014; Paggi et al. 2015)</td>
</tr>
<tr>
<td>D. exserta L.B.Sm.</td>
<td>Hutschbach &amp; Zelna 4117 (MBM, HB)</td>
<td>Ter, Rup</td>
<td>?</td>
<td>Brazil (MS), Paraguay (Smith &amp; Downs 1979)</td>
</tr>
<tr>
<td>D. ferruginea Mez</td>
<td>Pereira 383 (RB)</td>
<td>Ter</td>
<td>SDF</td>
<td>Brazil (MS, MT) (Smith &amp; Downs 1979, Forzza et al. 2014)</td>
</tr>
<tr>
<td>D. gracilis Mez</td>
<td>Ishii et al. 794 (COR)</td>
<td>Ter</td>
<td>Sav</td>
<td>Argentina, Bolivia, Brazil (MS) (Smith &amp; Downs 1979, Paggi et al. in press)</td>
</tr>
<tr>
<td>D. grandidentata P.J. Braun &amp; Esteves</td>
<td>Esteves &amp; Braun 659 (UFG*)</td>
<td>Rup</td>
<td>SDF</td>
<td>Brazil, Endemic to MS (Braun &amp; Pereira 2008)</td>
</tr>
<tr>
<td>D. leptostachya Baker</td>
<td>Hoehne 3548 (R)</td>
<td>Ter</td>
<td>Sav</td>
<td>Argentina, Bolivia, Brazil (MS, PR, RS, SC) (Smith &amp; Downs 1979)</td>
</tr>
<tr>
<td>D. paucispina Leme &amp; E.Esteves</td>
<td>Esteves &amp; Braun 378 (UFG*)</td>
<td>Rup</td>
<td>Sav</td>
<td>Brazil, Endemic to MS (Leme &amp; Pereira 2003)</td>
</tr>
<tr>
<td>D. pottiorum Leme</td>
<td>Leme et al. 8579 (HB, RB)</td>
<td>Rup</td>
<td>Sav</td>
<td>Brazil, Endemic to MS (Leme &amp; Pereira 2012)</td>
</tr>
<tr>
<td>D. stolonifera P.J.Braun &amp; Esteves</td>
<td>Esteves &amp; Braun 627 (UFG*)</td>
<td>Rup</td>
<td>SDF</td>
<td>Brazil, Endemic to MS (Braun &amp; Pereira 2009)</td>
</tr>
<tr>
<td>D. sp. 1</td>
<td>Kranz 139 (RB)</td>
<td>?</td>
<td>Sav</td>
<td>?</td>
</tr>
<tr>
<td>D. sp. 2</td>
<td>Hutschbach 60802 (MBM)</td>
<td>Ter, Rup</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Encholirium lymanianum E.Pereira &amp; Martinelli</td>
<td>Martinelli 400 (RB)</td>
<td>Rup</td>
<td>Sav</td>
<td>Brazil (MS, MT) (Forzza 2005)</td>
</tr>
<tr>
<td>Fosterella hatschbachii L.B.Sm. &amp; Read</td>
<td>Hutschbach 30497 (MBM, NY*)</td>
<td>Rup</td>
<td>SDF</td>
<td>Brazil (MS, MT) (Forzza et al. 2014)</td>
</tr>
<tr>
<td>Pitcairnia burchellii Mez</td>
<td>Hutschbach 24278 (MBM)</td>
<td>Rup</td>
<td>SDF</td>
<td>Brazil (DF, GO, MG, MS, MT, RO, TO) (Forzza et al. 2014)</td>
</tr>
<tr>
<td>P. matrogsensis E.Pereira &amp; Leme</td>
<td>Kautsky 896 (HB*)</td>
<td>?</td>
<td>?</td>
<td>Brazil, Endemic to MS (Pereira &amp; Leme 1986)</td>
</tr>
<tr>
<td>Pseudananas sagenarius (Arruda) Camargo</td>
<td>Ferreira 499 (RB)</td>
<td>Ter</td>
<td>SDF</td>
<td>South America (Smith &amp; Downs 1977)</td>
</tr>
<tr>
<td>Tillandsia bonita Versieux &amp; Martinelli</td>
<td>Martinelli 16923 (RB)</td>
<td>Epi</td>
<td>SDF</td>
<td>Brazil, Endemic to MS (Versieux et al. 2013)</td>
</tr>
<tr>
<td>T. bulchlohii Rauh</td>
<td>Rojas s.n. (LIL*)</td>
<td>Epi, Ter</td>
<td>SDF</td>
<td>Brazil (MS) and Paraguay (Till 1996)</td>
</tr>
<tr>
<td>T. didisticha (E.Morren) Baker</td>
<td>Hutschbach &amp; Ribas 72890 (MBM, RB)</td>
<td>Epi</td>
<td>Sav, SDF</td>
<td>Argentina, Brazil, Bolivia, Paraguay (Govaerts et al. 2005)</td>
</tr>
<tr>
<td>T. duratii Vis.</td>
<td>Lima 5562 (RB)</td>
<td>Epi</td>
<td>SDF</td>
<td>Southern South America (Govaerts et al. 2005)</td>
</tr>
</tbody>
</table>
plants from other Brazilian states. We could not thoroughly evaluate species delimitations/identifications within this genus, but we suggest that a visionary study of dyckias from MS should be done, since new records of populations in the field may greatly contribute to our knowledge about each species. The total number of species from MS may be underestimated, as indicated by three recently described species (Braun & Pereira 2008, 2009, Leme et al. 2012), all of them suffering with habitat loss. Recently, for the first time, natural populations of *D. excelsa* were found in ironstone outcrops (Corumbá and Ladário cities, Pantanal region, MS) (Paggi et al. 2015). This species was described based on a single individual from a private collection (Leme 1993), without describing the precise provenance. Such kind of field work may greatly contribute to a better understanding of these problematic taxa.

The ecological importance of Bromeliaceae is broadly cited in the literature (cf. Benzing 2000a). In MS, bromeliads are important sources of nectar for birds, as is the case of *Ananas ananassoides* and *Bromelia balansae* (Araújo & Sazima 2003, Faria & Araújo 2010). Some specimens examined here had annotations that indicated characteristics of plant populations. *Deuterocohnia meziana* occurs on limestone rocks and one specimen mentioned that there were mining activities close to the plant population. *Pseudananas sagenarius* is usually mentioned as an abundant species. On the other hand, *Dyckia* species and *Fosterella* are not common. Species of *Bromelia*, particularly *B. balansae* are traditionally used by native “pantaneiros” as medicine. This species is extremely common in some areas of the Pantanal wetland, where it grows forming dense and insurmountable clumps, and is one of the characteristic elements of this landscape, recorded in different studies (Araújo & Sazima 2003, Bueno et al. 2007).

**Main Research Groups, Collections, and future research**

The main groups researching Bromeliaceae in Brazil are centered in the Southeast region. However, nowadays there are researchers working with different aspects of bromeliads, such as systematics, physiology, morphology, reproductive biology, population genetics, phylogeography, evolution and cultivation in most of the Brazilian states. Considering the number of taxonomists available, Bromeliaceae ranks among the preferred plant families to be studied in Brazil, with at least 20 specialists (data from the Index Herbariorum).

**Considering** only the herbaria that have their collections data available through SpeciesLink, the largest bromeliad collections belong to the Mato Grosso do Sul Federal University Herbarium (CGMS), followed by Rio de Janeiro Botanic Garden (RB) and by the Embrapa Pantanal from Corumbá (CPAP). Also belonging to the Federal University of Mato Grosso do Sul, the herbarium of Corumbá (COR), although not available on-line yet, has 140 specimens of bromeliads. Most collections have less than 50 specimens (Fig. 1) and the total of specimens in the 20 collections available in the SpeciesLink is 471 (SpeciesLink 2014).

The collection effort should be increased in the entire state, allowing further biogeographical analysis. The number of specimens in the examined collection is still low and many of them were collected along roads. Given the profound landscape modifications that occurred in the last three decades in MS (cf. Braun & Pereira 2009) conservation measurements are necessary in order to clearly document the diversity of Bromeliaceae and their habitats in MS.

A complete taxonomic inventory of the Bromeliaceae from Mato Grosso do Sul should be done, increasing collection numbers and sampling all the different physiognomies. It is also a desirable goal to have a revision of *Dyckia* and *Tillandsia* species occurring there, since taxon delimitation in this group is problematic. Ecological niche modeling may be a good tool to be tested and to indicate potential areas of occurrence of species poorly known.
or that have lost most of their habitats by fragmentation. Integrating the knowledge of the plants in the field, with their potential distribution and conservation status will be of the utmost importance to set a clear plan to conserve as many species as possible. Creation of new reserves to protect the endemic and rare species should be encouraged and will be much appreciated.

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