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Asteraceae in the northern Espinhaço Range, Brazil: richness, endemism and conservation

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ABSTRACT

Floristic inventories focussing on the Espinhaço Range have revealed an extensive diversity for Asteraceae and emphasize the high degree of endemism of its species. This study aims to explore the species-rich Asteraceae through a floristic survey, and by identifying endemic records for the municipality of Morro do Chapéu, Bahia. Samples were collected during six field trips in different phytophysiognomies and approximately 1,400 exsiccatae from the main herbaria collections were examined. Asteraceae in Morro do Chapéu is represented by 18 tribes, 72 genera and 119 species. Eupatorieae and Vernonieae are the most species rich tribes and currently comprise 30 and 28 species, respectively, representing 50 % of the local Asteraceae flora. *Baccharis* represents the richest genus with seven species, followed by *Lepidaploa* and *Mikania* with six species each. Species belonging to Eupatorieae, namely *Acritopappus santosii*, *Acritopappus* sp. nov., *Lapidia apicifolia*, *Stylotrichium edmundoi*, *Scherya bahiensis*, *Trichogonia tombadorensis* and, additionally, a new species of Vernonieae, *Stilpnopappus* sp. nov., are endemic to the municipality. We provide a checklist and identification key for the species, and report the occurrence of endemism and their importance for the biological conservation.

Keywords: Campos rupestres, Chapada Diamantina, Compositae, Espinhaço Range, floristic survey

Introduction

Asteraceae is considered the most species-rich angiosperm family with approximately 24,700 species distributed among 1,600-1,700 genera (Funk *et al.* 2009). It exhibits a wide range of evolutionary strategies and different life forms (herbs, shrubs, subshrubs, trees and lianas), and has a cosmopolitan distribution, although most of its species occur in grassland vegetation in temperate and semi-arid climates of tropical and subtropical zones (Bremer 1994; Funk *et al.* 2009).

The family is recognized by a set of morphological characteristics that includes flowers arranged in a head, introrse anthers connate into a tube, secondary presentation of pollen and a 2-carpellate inferior ovary with a basal and erect ovule which develops in a cypsela usually possessing a pappus (Roque & Bautista 2008; Funk *et al.* 2009). It is recognized as a monophyletic group, and molecular studies (Panero & Funk 2008; Funk *et al.* 2009; Panero *et al.* 2014) have proposed a new classification that recognizes 13 subfamilies and 44 tribes.

Twenty-eight tribes of Asteraceae have been recorded in Brazil, represented by 287 genera and 2,086 species; 66 genera and 1,315 species are endemic and occur in all phytogeographic areas of the country (BFG 2015). The greatest diversity of Asteraceae is in areas of cerrado (savanna), campos rupestres

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(rocky fields), campos sulinos (southern grasslands), caatinga and restinga (sand dunes) (Hind & Miranda 2008).

Floristic surveys carried out in the Espinhaço Range have shown high species richness for Asteraceae, but particularly for Eupatorieae and Vernonieae, the most speciose tribes, followed by Helianteae and Astereae (Harley & Simmons 1986; Giulietti *et al*. 1987; Grandi *et al.* 1988; Pirani *et al.* 1994; Hind 1995; 2003; Guedes & Orge 1998; Zappi *et al.* 2003; Hatschbach *et al.* 2006; Moura & Roque 2014; Campos *et al.* 2016; Roque *et al*. 2016). These studies have confirmed that many species are common, yet have distributions restricted to the Espinhaço Range, whereas other species are micro-endemic to only one region, either in the state of Bahia or Minas Gerais (Giulietti *et al*. 1987; Giulietti & Pirani 1988; Harley 1995).

Approximately 125 genera and 500 species of Asteraceae have been documented in the campos rupestres of Espinhaço Range, of which 10 genera and about 75 species are endemic to Chapada Diamantina in Bahia (Roque *et al.* 2016). Thus, the focus of the present study was to perform a floristic inventory of Asteraceae and identify endemic records for the municipality of Morro do Chapéu in Chapada Diamantina, Bahia, Brazil.

Materials and methods

Study area

The Espinhaço Range extends approximately 1,000 km southwards from Serra da Jacobina in northern Bahia to Serra de Ouro Branco in southern Minas Gerais (40°47'06"-45°21'47"W 9°18'S-20°53'46"S), varying in width from 50 to 100 km and in elevation from 800 to 2033 m (Giulietti *et al.* 1987).

Several vegetation types associated with a series of elevational strata comprise the Espinhaço Range, which is considered the center of diversity for many groups of angiosperms and hosts about 15 % of the vascular flora of Brazil (Rapini *et al.* 2008; Silveira *et al.* 2015). Some 30 % of the plant species of the Espinhaço Range are endemic to the campos rupestres (Giulietti *et al.* 1987), a phytophysiognomy composed of herbs and shrubs growing in sandy and acidic soils between large rocky outcrops (Giulietti & Pirani 1988; Harley 1995; Pirani *et al.* 2003).

Chapada Diamantina belongs to the northern region of the Espinhaço Range, and can be divided into different types of natural vegetation, including caatinga, forest, cerrado and campos rupestres, all of which are extremely biologically diverse (Harley 1995).

The municipality of Morro do Chapéu is located in Chapada Diamantina within the semi-arid region of Bahia, and is characterized by tabular reliefs ranging between 480 m and 1,293 m in elevation (Rocha & Costa 1995).

The landscape reflects the climatic particularities within the so-called "Polígono das Secas" including mountainous formations with pronounced scarps, deep valleys and high plateaus (Barbosa 1995). Due to the spatial and temporal variation inherent in the pluviometric regime of the region, including its intensity, different vegetation formations can develop on the same type of soil. Furthermore, the region is characterized by structurally compartmentalized reliefs, which generate different mesoclimates in adjacent areas (Silva 1995).

Morro do Chapéu is classified as an area of high priority for preservation in the Chapada Diamantina due to the fact that it possesses a unique vegetation typology of the caatinga (Maury 2002). According to Queiroz *et al.* (2005), within the Parque Estadual de Morro do Chapéu, the "Cidade das Pedras" exhibits a set of distinctive features because it possesses caatinga that is characterized by a flattened relief with different quartzite-arenite outcrops and extensive dune fields, possibly resulting from the effect of strong winds.

Morro do Chapéu encompases three conservation units, the Parque Estadual de Morro do Chapéu, APA Vereda do Romão Gramacho/Gruta dos Brejões and Monumento Natural da Cachoeira do Ferro Doido , which aid in the protection of the region's environment (Rocha *et al.* 2005; Rocha & Pedreira 2009).

Floristic survey

Six field expeditions were carried out between November of 2014 and March of 2016, to survey species of Asteraceae. Fieldwork was schedule taking into account the main seasonal and pluviometric variation in the region. The main herbaria storing floral material from Chapada Diamantina were visited, and included ALCB, CEPEC, HUEFS, HRB, RB, R, SP and SPF (acronyms according to Thiers 2017), and approximately 1,400 exsiccatae were analyzed.

The principal collection sites for species of Asteraceae, and a set of photographs showing the different landscapes of the municipality of Morro do Chapéu, are provided in Figure 1. The map provided here was generated with ArcMap (version 10). Terminology for forest phytophysiognomies is based on the classification system proposed by IBGE (2012), whereas that for campos rupestres followed Giulietti *et al.* (1987) and that of caatinga vegetation followed Rizzini (1997).

The collection strategy involved random walking around the main access road and secondary smaller trails. Collected material was geo-referenced and processed according to Peixoto & Maia (2003). All material was deposited in the ALCB herbarium with duplicates being sent to HUEFS. Species identification was aided by specific literature, protologues, comparisons with dried material and virtual collections.

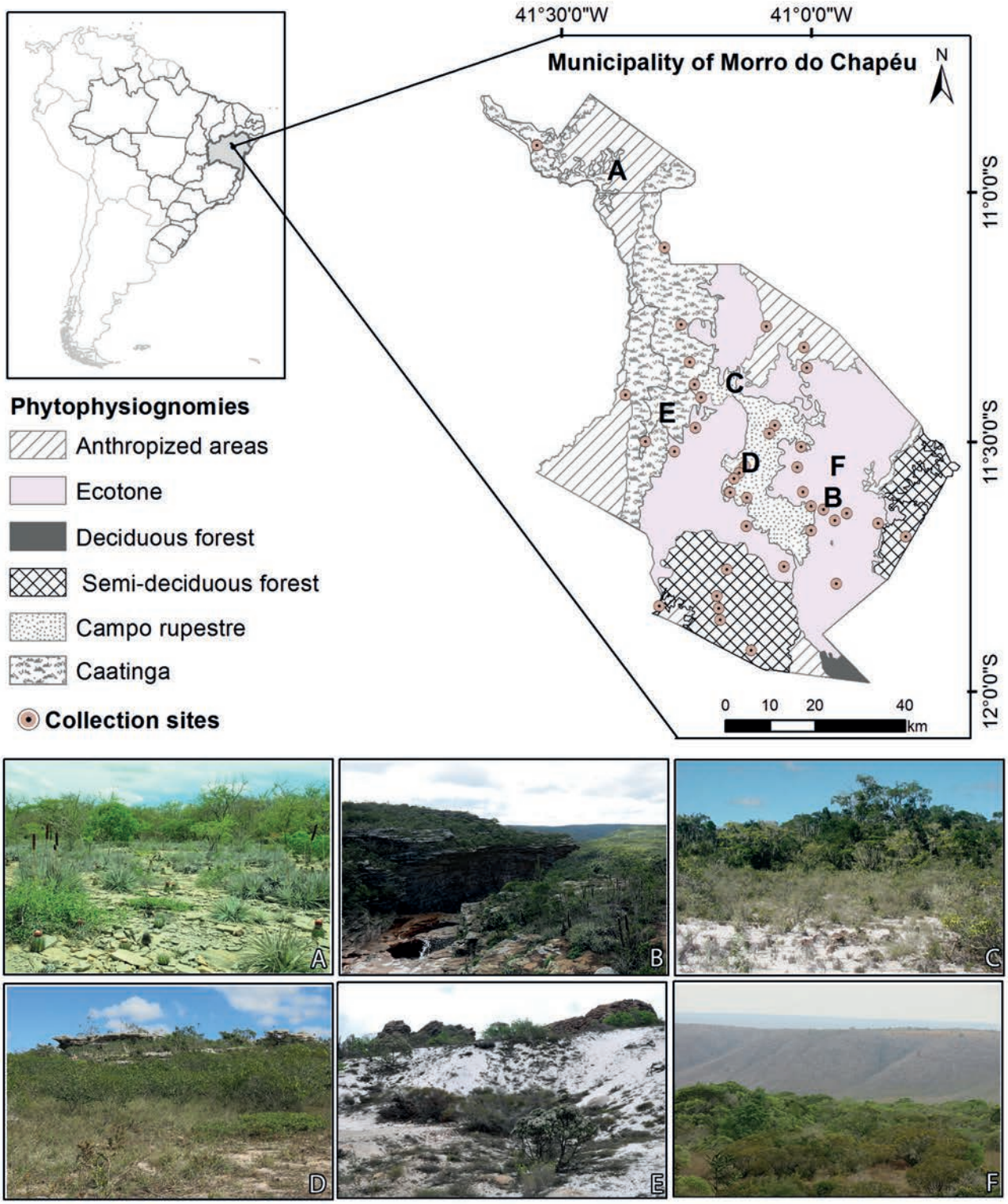

Figure 1. Map of the municipality of Morro do Chapéu with the main collection sites of the Asteraceae species and a set of pictures taken from the region's different landscapes: **A** – Gruta dos Brejões; **B** – Cachoeira do Ferro do Doido; **C** – Trilha da Guariba; **D** – Tabuleiro do Tigre; **E** – Parque Estadual de Morro do Chapéu (Cidade das Pedras); **F** – Trilha da Veredinha (A–D. Cardoso; B, C, D, F–M. Staudt; E–L. Barres).

Table 1. List of Asteraceae species from Morro do Chapéu, Bahia, Brazil; ■ Endemic species of Bahia; ● Endemic species of Morro do Chapéu; Phytophysiognomies: CA-caatinga; CR- campo rupestre; SDF- semi-deciduous forest; Ecotone (CAC – caatinga and campo rupestre; CEC – cerrado and campo rupestre); AA-anthropized area; Collection voucher.

Tribe/species	Phytophysiognomies	Voucher
Barnadesieae (1 genus/3 species)		
Dasyphyllum brasiliense (Spreng.) Cabrera	SDF	E. Melo *et* al. 5035
■ *Dasyphyllum diamantinense* Saavedra & M. Monge	SDF	H.P. Bautista *et. al* 1061
Dasyphyllum sprengelianum (Gardner) Cabrera	CA	E. Melo *et al.* 4491
Mutisieae (1genus/1 species)		
Chaptalia integerrima (Vell.) Burkart	CR/SDF/CEC/AA	M.G. Staudt *et al.* 35
Nassauvieae (1 genus/4 species)		
Trixis antimenorrhoea (Schrank) Mart ex. Kuntze	CA/CR/SDF/AA	M.G. Staudt *et al.* 30
Trixis calycina D. Don.	CA/CR	M.G. Staudt *et al.* 81
■ *Trixis pruskii* D.J.N. Hind	CA/SDF/CEC	E. Melo *et al.* 5509
Trixis vauthieri DC.	CA/CR/CEC	M.G. Staudt *et al.* 94
Gochnatieae (2 genera/3 species)		
Richterago discoidea (Less.) Kuntze	CR	M.L. Guedes *et al.* 10796
Moquiniastrum blanchetianum (DC.) G. Sancho	CAC	M.G. Staudt *et al.* 111
Moquiniastrum oligocephalum (Gardner) G. Sancho	CAC	M.G. Staudt *et al.* 142
Cichorieae (1 genus/1 species)		
Sonchus oleraceus L.	CR	N. Hind *et al.* 3173
Vernonieae (13 genera/28 species)		
Albertinia brasiliensis Spreng.	CA	E. Melo *et al.* 3185
Blanchetia heterotricha DC.	CA/SDF	M.G. Staudt *et al.* 36
Centratherum punctatum Cass.	CA/CR/SDF/AA	M.G. Staudt *et al.* 99
Chresta pacourinoides C.M. Siniscalchi & B. Loeuille	CA	J.M. Gonçalves *et al.* 124
Cyrtocymura harleyi (H. Rob.) H. Rob.	CR	M.G. Staudt *et al.* 157
Cyrtocymura scorpioides (Lam.) H. Rob.	CR/SDF	M.G. Staudt *et al.* 34
Elephantopus hirtiflorus DC.	CR	M.G. Staudt *et al.* 68
Elephantopus mollis Kunth	CR/SDF	N. Hind *et al.* 3105
Eremanthus capitatus (Spreng.) MacLeish	CR/SDF/CEC	M.G. Staudt *et al.* 73
Eremanthus glomerulatus Less.	CA/CR	M.G. Staudt *et al.* 79
Lepidaploa aurea (Mart. ex DC.) H. Rob.	CA/CR/FES/CEC	M.G. Staudt *et al.* 147
■ *Lepidaploa bahiana* H. Rob.	CR	M.G. Staudt *et al.* 78
Lepidaploa chalybaea (Mart. ex DC.) H. Rob.	CA/CR/SDF	M.G. Staudt *et al.* 84
Lepidaploa cotoneaster (Willd. ex Spreng.) H. Rob.	CR/CA/SDF/CEC	M.G. Staudt *et al.* 105
Lepidaploa lilacina (Mart. ex DC.) H. Rob.	CA/CR/CAC	M.G. Staudt *et al.* 122
■ *Lepidaploa tombadorensis* (H. Rob.) H. Rob.	CA/CR/CAC	M.G. Staudt *et al.* 91
Lessingianthus morii (H. Rob.) H. Rob.	CR	R.M. Harley 19242
■ *Paralychnophora harleyi* (H. Rob.) D.J.N. Hind.	CR	G. Martinelli *et al.* 5318
Paralychnophora reflexoauriculata (G.M. Barroso) MacLeish	CR/SDF/CEC	M.G. Staudt *et al.* 71
Piptocarpha leprosa (Less.) Baker	CEC	E. Melo *et al.* 9612
■ *Stilpnopappus semirianus* R. Esteves	CR/CEC	M.G. Staudt *et al.* 62
Stilpnopappus suffruticosus Gardner	CR	M.G. Staudt *et al.* 109
■ *Stilpnopappus tomentosus* Mart. ex DC.	CR	H.A. Ogasawara *et al.* 393
● *Stilpnopappus* sp. nov.	CR	M.G. Staudt *et al.* 03
Vernonanthura brasiliana (L.) H. Rob.	CA/SDF/CAC	M.G. Staudt *et al.* 98
Vernonanthura laxa (Gardner) H. Rob.	CEC	E.E. de Miranda 13
Vernonanthura polyanthes (Spreng.) A.J. Vega & M. Dematt.	CA/SDF	F. França *et al.* 5851
Vernonanthura subverticillata (Sch. Bip. ex Baker) H. Rob.	CA/CAC/CEC	E. Melo *et al.* 10020
Moquinieae (1 genus/1 species)		
Moquinia racemosa (Spreng.) DC.	CR/CAC	M.G. Staudt *et al.* 125
Gnaphalieae (2 genera/2 species)		
Achyrocline satureioides (Lam.) DC.	CR/AA	M.G. Staudt *et al.* 123
Gamochaeta americana (Mill.) Wedd.	CR/AA	J.L. Ferreira *et al.* 63
Astereae (3 genera/10 species)		
■ *Baccharis alleluia* A.S. Oliveira & Deble	CA	J.P. Souza s/n°
Baccharis calvescens DC.	CA/AA	R.M. Harley *et al.* 19395

Table 1. Cont.

Tribe/species	Phytophysiognomies	Voucher
Baccharis cinerea DC.	CA/CR/AA	R.M. Harley *et al.* 3279
Baccharis linearifolia (Lam.) Pers.	CR/SDF	R. Orlandini 272
Baccharis retusa DC.	SDF	E.B. Miranda *et al.* 100
Baccharis reticularia DC.	CR	S.A. Mori *et al.* 14451
Baccharis trinervis Pers.	SDF	E. Melo *et al.* 11163
Conyza primulifolia (Lam.) Cuatrec. & Lourteig	CR/AA	R.M. Harley *et al.* 19311
Conyza sumatrensis (Retz.) E. Walker	CR/AA	N. Hind *et al.* 3239
Egletes viscosa (L.) Less.	CA/AA	E. Melo *et al.* 11140
Anthemideae (1genus/1 species)		
Artemisia vulgaris L.	AA	N.C.B. Silva 90
Inuleae (3 genera/3 species)		
Epaltes brasiliensis DC.	CA	F. França *et al.* 6101
Pluchea sagittalis (Lam.) Cabrera	CA/AA	R.F. Machado 406
Pterocaulon alopecuroides (Lam.) DC.	SDF	J.M. Gonçalves *et al.* 39
Senecioneae (4 genera/4 species)		
Emilia fosbergii Nicolson	CR/SDF/AA	M.G. Staudt *et al.* 75
Erechtites hieracifolius (L.) Raf. ex DC.	AA	H.P. Bautista 373
■ *Hoehnephytum almasense* D.J.N. Hind	CR	H.S. Irwin *et al.* 32422
Senecio macrotis Baker	CA	E. Pereira 2144
Neurolaeneae (2 genera/2 species)		
Enydra radicans (Willd.) Lack	CA/AA	F. França *et al.* 6077
Calea candolleana (Gardner) Baker	CA/CR/CAC	M.G. Staudt *et al.* 137
Heliantheae (15 genera/19 species)		
Acmella ciliata (Kunth) Cass.	CA/SDF	F.B. Silva *et al.* 36
Acmella uliginosa (Sw.) Cass.	CA/SDF	M.G. Staudt *et al.* 101
Ambrosia artemisiifolia L.	AA	E. Melo *et al.* 11144
Aspilia martii Baker	CR	M.G. Staudt *et al.* 110
Aspilia subalpestris Baker	SDF/CEC	A. Gandara *et al.* 83
Baltimora geminata (Brandegee) Stuessy	CA	E. Melo *et* al. 5662
Blainvillea acmella (L.) Philipson	CR	M. Alves *et al.* 137
Delilia biflora (L.) Kuntze	SDF	M.G. Staudt *et al.* 39
Eclipta prostrata (L.) L.	AA	E. Melo *et al.* 3153
Melanthera latifolia (Gardner) Cabrera	CR	Pe. Pereira *et al.* s/n°
Simsia dombeyana DC.	CA	E. Melo *et al.* 4739
Synedrellopsis grisebachii Hieron. & Kuntze	CA	L.P. Queiroz *et al.* 13219
Tilesia baccata (L.) Pruski	CEC	E. Melo *et al.* 12117
Tithonia diversifolia (Hemsl.) A. Gray	AA	M. Alves *et al.* 140
Tithonia rotundifolia (Mill.) S.F. Blake	AA	M. Alves *et al.* 136
Verbesina glabrata Hook. & Arn.	CA/CR	E. Melo *et al.* 5072
Verbesina macrophylla (Cass.) S.F. Blake	CR/SDF/CEC/AA	M.G. Staudt *et al.* 46
Wedelia goyazensis Gardner	CA	M.G. Staudt *et al.* 29
Zinnia elegans Jacq.	AA	M.G. Staudt *et al.* 40
Coreopsideae (1 genus/1 species)		
Bidens pilosa L.	CR/AA	N. Hind *et al.* 3242
Tageteae (2 genera/3 species)		
Porophyllum obscurum (Spreng.) DC.	CR	H.P. Bautista *et al.* 2507
Porophyllum ruderale (Jacq.) Cass.	CR	M.L. Guedes *et al.*102251
Tagetes minuta L.	CA/CR/AA	M.G. Staudt *et al.* 13
Millerieae (2 genera/3 species)		
Acanthospermum australe (Loefl.) Kuntze	CR	N. Hind *et al.* 3237
Acanthospermum hispidum DC.	CR/AA	N. Hind *et al.* 3091
Tridax procumbens L.	SDF/AA	M.G. Staudt *et al.* 41
Eupatorieae (17 genera/30 species)		
Acritopappus confertus (Gardner) R.M. King & H. Rob.	CA/CR/CAC/CEC	M.G. Staudt *et al.* 116
■ *Acritopappus heterolepis* (Baker) R.M. King & H. Rob.	SDF	M.G. Staudt *et al.* 126
■ *Acritopappus prunifolius* R.M. King & H. Rob.	CEC	R.M. Harley 22994

Table 1. Cont.

Tribe/species	Phytophysiognomies	Voucher
● *Acritopappus santosii* R.M. King & H. Rob.	CA/CR/CAC/CEC	M.G. Staudt *et al.* 139
● *Acritopappus* sp. nov.	CA/SDF	M.G. Staudt *et al.* 104
Ageratum conyzoides L.	CR/AA	M.G. Staudt *et al.* 100
■ *Agrianthus empetrifolius* Mart. ex DC.	CR	E. Melo *et al.* 5068
Bahianthus viscosus (Spreng.) R.M. King & H. Rob.	CR	H.P. Bautista 2948
Bejaranoa semistriata (Baker) R.M. King & H. Rob.	CA/CR	M.G. Staudt *et al.* 102
■ *Chromolaena morii* R.M. King & H. Rob.	CR	M.G. Staudt *et al.* 120
Chromolaena maximilianii (Schrad. ex DC.) R.M. King & H. Rob.	CR/SDF	M.G. Staudt *et al.* 33
Conocliniopsis prasiifolia (DC.) R.M. King & H. Rob.	CA/CR	M.G. Staudt *et al.* 72
Koanophyllon conglobatum (DC.) R.M. King & H. Rob.	CR	R.P. Orlandini 460
● *Lapidia apicifolia* N. Roque & S.C. Ferreira	CR	M.G. Staudt *et al.* 74
Mikania congesta DC.	CR/SDF/AA	E. Melo *et al.* 8460
Mikania cordifolia (L.f.) Willd.	CA	M.L. Guedes *et al.* 12985
Mikania elliptica DC.	CR/SDF	M.G. Staudt *et al.* 95
Mikania glomerata Spreng.	SDF	M.L. Guedes *et al.* 10797
■ *Mikania grazielae* R.M.King & H.Rob.	SDF	A. Gandara *et al.* 137
Mikania phaeoclados Mart.	CR/SDF	G. Hatschbach 39673
■ *Prolobus nitidulus* (Baker) R.M. King & H. Rob.	CR	M G. Staudt *et al.* 67
Pseudobrickellia brasiliensis (Spreng.) R.M. King & H. Rob.	CR	M.L. Guedes *et al.* 16279
● *Scherya bahiensis* R.M. King & H. Rob.	CR	M.G. Staudt *et al.* 130
Stevia morii R.M. King & H. Rob.	CR	H.P. Bautista 405
■ *Stylotrichium corymbosum* (DC.) Mattf.	CR	J.L. Ferreira *et al.* 43
● *Stylotrichium edmundoi* G.M. Barroso	CR	M.G. Staudt *et al.* 113
Symphyopappus decussatus Turcz.	SDF	A.A. Conceição *et al.* 2434
Trichogonia campestris Gardner	CA/CR/AA	M.G. Staudt *et al.* 150
Trichogonia salviifolia Gardner	CA/CR/SDF/AA	M.G. Staudt *et al.* 129
● *Trichogonia tombadorensis* R.M. King & H. Rob.	CR	M.G. Staudt *et al.* 149

The presentation of the tribes follows Funk *et al.* (2009), starting with the Barnadesieae and finishing with the Eupatorieae. Within each tribe, genera and respective species are listed in alphabetic order (Tab.1, Figs. 2-8).

Results and discussion

Asteraceae in Morro do Chapéu

In Morro do Chapéu, Asteraceae is represented by 18 tribes, 72 genera and 119 species (Tab. 1). Corroborating previous floristic surveys in Espinhaço Range (Giulietti *et al.* 1987; Hind 1995; 2003; Zappi *et al.* 2003; Moura & Roque 2014; Campos *et al.* 2016; Roque *et al.* 2016), Eupatorieae and Vernonieae were the most diverse tribes with 30 and 28 species respectively, and together comprise 50 % of the local diversity of Asteraceae. Heliantheae was the third most diverse tribe with 19 species, representing about a third of Heliantheae species registered in the state of Bahia by Alves & Roque (2016).

Baccharis was the richest genus with seven species, followed by *Lepidaploa* and *Mikania*, with six species each; results similar to those observed in other areas of Chapada Diamantina (Harley 1995; Zappi *et al.* 2003; Moura & Roque 2014; Roque *et al.* 2016). Other speciose genera included *Acritopappus* with five species; *Stilpnopappus*, *Trixis*, and *Vernonanthura*, with four species each; and *Dasyphyllum* and *Trichogonia* with three each. The remaining genera were represented by only one or two species each, and represented 60 % of the species of Asteraceae in the area.

Seven genera found at Morro do Chapéu are monotypic (*Albertinia*, *Bahianthus*, *Conocliniopsis*, *Lapidia*, *Prolobus*, *Scherya* and *Synedrellopsis*), while 23 species are endemic to the state of Bahia, of which 19 belong to the tribes Eupatorieae and Vernonieae (Tab. 1).

Morro do Chapéu is the type locality for *Acritopappus prunifolius, Cyrtocymura harleyi*, *Lepidaploa tombadorensis* and *Stilpnopappus semirianus*. Moreover, *Acritopappus santosii*, *Acritopappus* sp. nov., *Lapidia apicifolia*, *Stylotrichium edmundoi*, *Scherya bahiensis* and *Trichogonia tombadorensis*, all belonging to the tribe Eupatorieae, and a new species, *Stilpnopappus* sp. nov. of to the tribe Vernonieae, are recorded as endemic to the municipality (Tab. 1).

Stilpnopappus suffruticosus is here recorded as a new record for the state of Bahia, and is classified as endangered in the Red Book (Martinelli & Moraes 2013), even as *Paralychnophora harleyi*, *Stilpnopappus semirianus*, *Stylotrichium corymbosum* and *Stylotrichium edmundoi*.

Figure 2. A – *Dasyphyllum brasiliense*; **B** – *Dasyphyllum sprengelianum*; **C** – *Chaptalia integerrima*; **D** – *Trixis calycina*; **E** – *Trixis vauthieri*; **F** – *Richterago discoidea*; **G** –*Moquiniastrum blanchetianum*; **H** – *Moquiniastrum oligocephalum* (A, B, H–N. Roque; C–A. Gandara; D, E, G–L. Barres; F–L. Moura).

Figure 3. A – *Sonchus oleraceus*; **B** – *Albertinia brasiliensis;* **C** – *Blanchetia heterotricha;* **D** – *Centratherum punctatum*; **E** – *Chresta pacourinoides;* **F** – *Cyrtocymura harleyi;* **G** – *Cyrtocymura scorpioides*; **H** – *Eremanthus capitatus*; **I** – *Eremanthus glomerulatus;* **J** – *Lepidaploa aurea;* **K** – *Lepidaploa bahiana*; **L** – *Lepidaploa chalybaea;* **M** – *Lepidaploa cotoneaster* (A–V. Amorim; B–H. Ogasawara; C, D, F–A. Gandara; E–L. Campos; G – L. Pataro; H, K, I – L. Barres; J, L, M – M. Staudt).

Figure 4. A – *Lepidaploa lilacina*; **B** – *Lepidaploa tombadorensis*; **C** – *Paralychnophora reflexoauriculata*; **D** – *Stilpnopappus semirianus*; **E** – *Stilpnopappus* sp. nov.; **F** – *Vernonanthura brasiliana*; **G** – *Vernonanthura polyanthes*; **H** – *Vernonanthura subverticillata*; **I** – *Moquinia racemosa* (A, D – A. Gandara; B, C – L. Barres; E – M. Staudt; F – H. Ogasawara; G- L. Moura; H – L. Pataro; I – M. Alves).

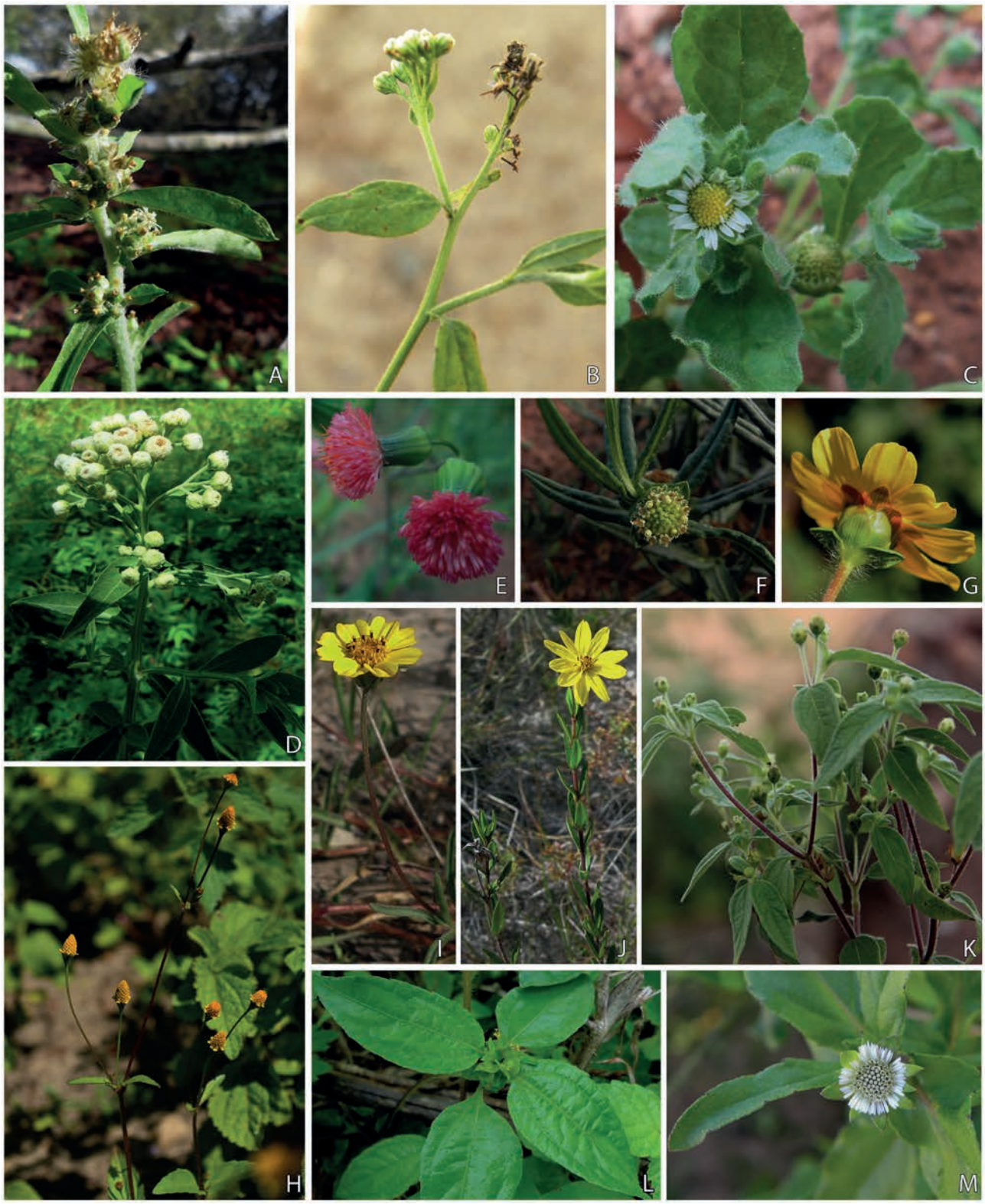

Figure 5. A – *Gamochaeta americana*; **B** – *Baccharis cinerea;* **C** – *Egletes viscosa*; **D** – *Pluchea sagittalis*; **E** – *Emilia fosbergii*; **F** – *Enydra radicans*; **G** – *Calea candolleana*; **H** – *Acmella uliginosa;* **I** – *Aspilia martii*; **J** – *Aspilia subalpestris*; **K** – *Blainvillea acmella*; **L** – *Delilia biflora*; **M** – *Eclipta prostrata* (A, C, D, E, F, L, M – V. Amorim; B, G, H – A. Gandara; I – M. Staudt; J – M. Alves; K – L. Moura).

Figure 6. A – *Melantheera latifolia*; **B** – *Tilesia baccata*; **C** – *Tithonia diversifolia*; **D** – *Tithonia rotundifolia*; **E** – *Verbesina glabrata*; **F** – *Verbesina macrophylla*; **G** – *Wedelia goyazensis*; **H** – *Zinnia elegans*; **I** – *Bidens pilosa* (A, B – V. Amorim; C, D, F, H – L. Moura; E – M. Alves; G, I – A. Gandara).

Figure 7. A – *Porophyllum obscurum*; **B** – *Porophyllum ruderale*; **C** – *Tagetes minuta*; **D** – *Acanthospermum australe*; **E** – *Acanthospermum hispidum*; **F** – *Tridax procumbens*; **G** – *Acritopappus confertus*; **H** – *Acritopappus heterolepis*; **I** – *Acritopappus prunifolius*; **J** – *Acritopappus santosii*; **K** – *Ageratum conyzoides*; **L** – *Agrianthus empetrifolius*; **M** – *Bahianthus viscosus* (A – L. Barres; B, L – V, Amorim; C, E, F, M – L. Moura; D, K – A. Gandara; G, J – M. Staudt; H – M. Alves; I – H. Ogasawara).

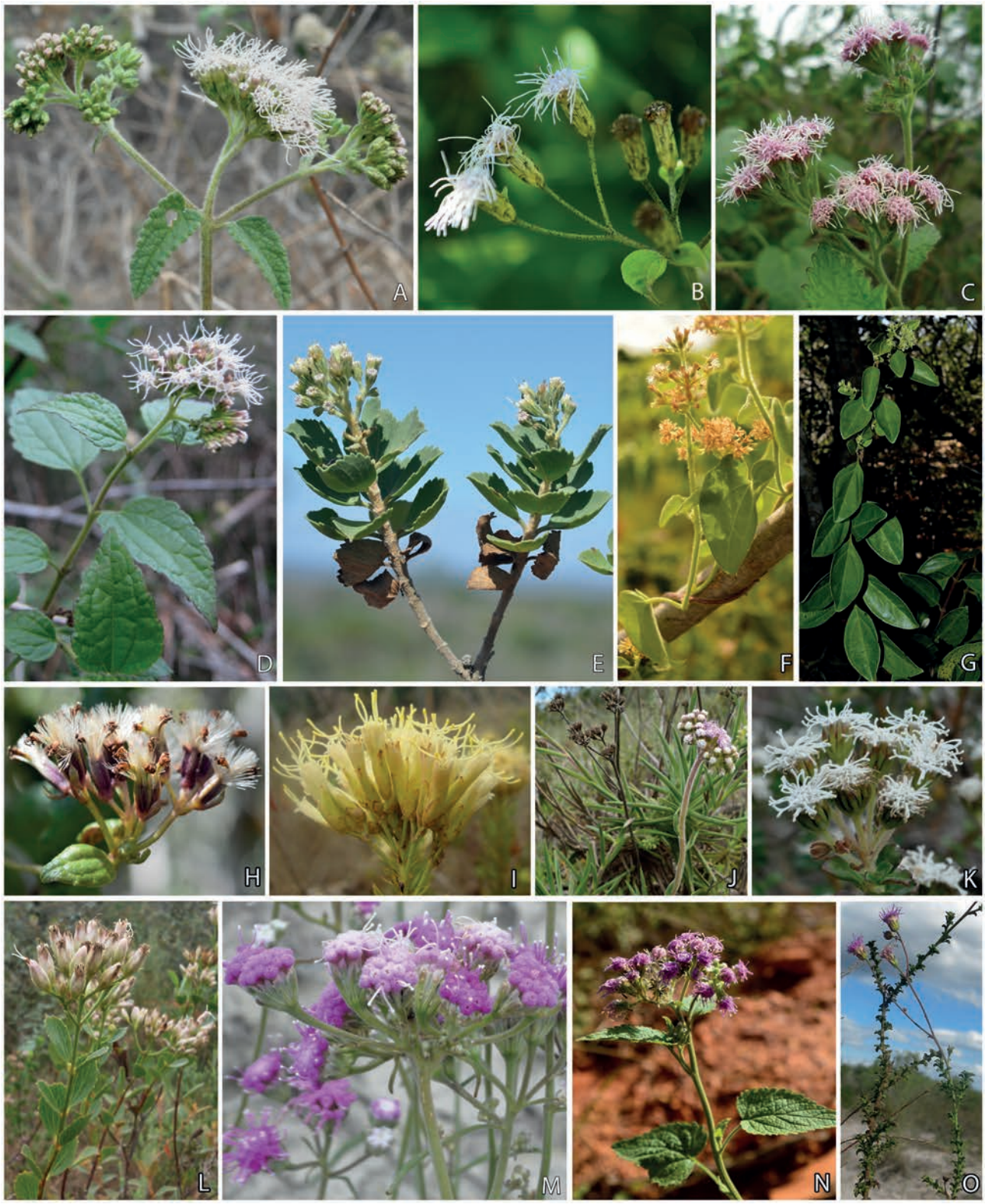

Figure 8. A - *Bejaranoa semistriata*; **B** - *Chromolaena maximilianii*; **C** - *Conocliniopsis prasiifolia*; **D** - *Koanophyllon conglobatum*; **E** - *Lapidia apicifolia*; **F** - *Mikania congesta*; **G** - *Mikania elliptica*; **H** – *Mikania grazielae*; **I**- *Pseudobrickellia brasiliensis*; **J** - *Scherya bahiensis*; **K** - *Stylotrichium edmundoi*; **L** – *Symphyopappus decussatus*; **M** - *Trichogonia campestris*; **N** - *Trichogonia salviifolia*; **O** - *Trichogonia tombadorensis* (A, E, J, K – L. Barres; B, F, G, H, N – A. Gandara; C, D, L – V. Amorim; I – N. Roque; M, O – M. Staudt).

Diversity and phytophysiognomies: specifics regarding Asteraceae

Studies on the flora of Morro do Chapéu reveal that the vegetation found in the northeastern region of the municipality is predominantly composed of arboreal-shrubby caatinga. Meanwhile, extensive areas of campos rupestres can be found in the central region, whereas semi-deciduous forests are located in the southwest and southeast. Associated with these phytophysiognomies, gallery forests and ecotonal vegetation exhibit complex areas of transition depending on topography and elevation (Silva 1995; França & Melo 2013).

The distribution of *Dasyphlyllum diamantinense,* included in a basal tribe of Asteraceae, is restricted to the region of Chapada Diamantina (Saavedra *et al.* 2014), where it can be found in semi-deciduous forest throughout the study area. The other species of this genus that occur in the region (*D. brasiliense* and *D. sprengelianum*) can be found in carrasco and caatinga areas.

Considered an endemic of Bahia, *Trixis pruskii* occurs predominantly in gallery forest in sandy soils or between rocks. The other species of this genus that occur in the region (*T. antimenorrhoea*, *T. calycina* and *T. vauthieri*) are found in other phytophysiognomies, such as border parts of semi-deciduous seasonal forest, or ecotones between campo rupestre and caatinga vegetation.

Richterago is an endemic genus of Brazil, and although more than half of its species are restricted to Espinhaço Range (Roque & Pirani 2014), only one species, *Richterago discoidea*, was found to occur in the study area. *Moquiniastrum* shows two of the six recognized species in the State of Bahia., *M. blanchetianum* and *M. oligocephalum* are found in transitional areas between campo rupestre and caatinga at elevations above 1000 m on sandy soils, but without rocky outcrops.

The genera *Stilpnopappus* and *Vernonanthura*, represented by four species each, and the genus *Eremanthus*, represented by two, were the predominant groups of Vernonieae in Morro do Chapéu, where they occurred in transitional areas.

The absence of species of *Lychnophora*, and the low number of species of *Lessingianthus*, reveal an unusual pattern compared to other areas in Espinhaço Range, since both genera have their greatest diversity in cerrado and campo rupestre phytophysiognomies (Giulietti *et al.* 1987; Hind 1995; Pirani *et al.* 2003; Zappi *et al.* 2003; Moura & Roque 2014; Campos *et al.* 2016; Roque *et al.* 2016).

According to Fiaschi & Pirani (2009), *Lychnophora* and *Eremanthus* are key elements for understanding the origin of the flora endemic to the cerrado. Therefore, the lack, or low representation, of, these genera may be associated with the difficulty in delimiting areas of cerrado *sensu stricto* in Morro do Chapéu.

The species *Acritopappus confertus*, *Aspilia martii*, *Calea candolleana*, *Eremanthus capitatus*, *Lepidaploa aurea* and *Lepidaploa lilacina* are widely distributed throughout different phytophysiognomies of Morro do Chapéu, such as campos rupestres, transition zones between campo rupestre and the caatinga, and the outermost parts of semi-deciduous seasonal forests.

On the other hand, *Agrianthus empetrifolius*, *Cyrtocymura harleyi* and *Stilpnopappus tomentosus* are found predominantly in campo rupestre vegetation where they are restricted to rocky outcrops. *Scherya bahiensis*, *Stilpnopappus* sp. nov. and *Stylotrichium edmundoi* are considered micro-endemics of a specific area of campos rupestres called the "Tabuleiro do Tigre" (Fig. 1D). Apart from these species, *Acritopappus santosii*, *Lapidia apicifolia* and *Trichogonia tombadorensis* are also identified as endemic to Morro do Chapéu. According to Conceição *et al.* (2005), this microendemism is particularly influential in campos rupestres where a significant part of the diversity is composed of less frequently occurring species.

Among the patterns of geographic distribution proposed for the flora of campos rupestres by Giulietti & Pirani (1988), one specific pattern can be highlighted, that comprising species whose occurrence is restricted to Espinhaço Range. This pattern can be divided into two subgroups. The first group encompasses species whose occurrence is restricted to campos rupestres, but at the same time are widely distributed throughout the Espinhaço Range. The second group encompasses species that are endemic to one specific locality or to only a few regions of the Espinhaço Range located in the state of Minas Gerais, or in the Chapada Diamantina in the state of Bahia. Thus, the endemic species of Morro do Chapéu can be subsumed into the second subgroup. As pointed out by Conceição & Pirani (2005), the contiguity between different habitat types produces a high degree of heterogeneity in floristic structure and composition in certain restricted areas, reflecting variation in substrates. This phenomenon, therefore, contributes to the high number of endemic species of campo rupestre.

According to Zappi (2008), the implementation of an environmental protection area and the development of management plans have to be regarded as extremely relevant in the case of Morro do Chapéu, where the unique enclaves of the caatinga and campo rupestre are endangered. In this sense, further studies on the taxonomy, ecology and biogeography of the representative and endemic groups found in the campos rupestres of Espinhaço Range is considered essential. These studies can provide crucial information regarding evolutionary patterns that have determined the origin of rare species, and thus can provide insight into conservation. Furthermore, they can provide important criteria for the development of strategies for biodiversity conservation (Kruckeberg & Rabnowitz 1985; Rapini *et al.* 2008; Rapini *et al.* 2009).

In this sense, it is important to emphasize that Morro do Chapéu possesses unique floristic diversity, and a significant number of species of Asteraceae possess restricted distributions and high degrees of endemism. We stress that this floristic diversity is constantly at high risk of becoming endangered due to population reductions and loss of habitat, particularly considering the intense activities involving sand-extraction and growing exploitation for agriculture.

Key to the Asteraceae species from Morro do Chapéu, Bahia, Brazil

1. Discoid (flowers with one corolla type: tubulose, bilabiate or ligulate) or disciform heads (flowers with two or three corolla types, always including corolla tubulose-filiform).
2. Stems with geminate axillary spines; lamina and involucral bracts with apex mucronate or spinescent.
3. Capitulescence cymose; involucre 2-3 × 1.5-2.2 cm; heads 20-60 flowers (Fig. 2B) ..... *Dasyphyllum sprengelianum*
3'. Capitulescence paniculiform or racemiform; involucre 1-1,5 × 0,5-1,1 cm; heads 10-15 flowers.
4. Spines larger or the same size as leaves; lamina with apex apiculate or aristate; involucre cylindrical .... *Dasyphyllum diamantinense*
4'. Spines smaller than leaves or stems without spines; lamina with apex inermous or mucronate; involucre campanulate (Fig. 2A) ..... *Dasyphyllum brasiliense*
2'. Stems without spines; lamina and involucral bracts not mucronate or spinescent at apex.
5. Heads with all flowers with corolla bilabiate.
6. Lamina concolorous; involucre uniseriate ..... *Trixis pruskii*
6'. Lamina discolorous; involucre 2-seriate.
7. Stems winged, viscid; involucral bracts with dense trichomes at the apex (Fig. 2E) ..... *Trixis vauthieri*
7'. Stems cylindrical, not viscid; involucral bracts without tufts of trichomes at the apex.
8. Leaves sessile, persistent; capitulescence with flowering branches divaricate ..... *Trixis antimenorrhoea*
8'. Leaves petiolate, deciduous, pubescent scars on the stems; capitulescence without flowering branches divaricated (Fig. 2D) ..... *Trixis calycina*
5'. Heads with flowers with corolla tubular, tubular-filiform or ligulate.
9. Plants with latex; all flowers with corolla ligulate (Fig. 3A) ..... *Sonchus oleraceus*
9'. Plants without latex; flowers with corolla tubular, tubular-filiform and/or ligulate.
10. Leaves and involucral bracts with glandular and aromatic pockets (dark dots or lines).
11. Leaf blade linear or filiform (Fig. 7A) ..... *Porophyllum obscurum*
11'. Leaf blade elliptic (Fig. 7B) ..... *Porophyllum ruderale*
10'. Leaves and involucral bracts without glandular and aromatic pockets.
12. Heads unisexual (head pistillate uniflorous, flower without corolla; head staminate with several flowers and involucral bracts connate), plant monoecious ..... *Ambrosia artemisiifolia*
12'. Heads bisexual (flowers with corolla), if unisexual, plant dioecious or gynodioecious.
13. Involucral bracts hyaline, white or yellow.
14. Corolla purple or lilac; pappus of bristles connate at the base (Fig. 5A) ..... *Gamochaeta americana*
14'. Corolla yellow or white-yellow; pappus of free bristles ..... *Achyrocline satureioides*
13'. Involucral bracts opaque, green, brown or vinaceous.
15. Heads with trimorphic flowers (ray flowers with corolla ligulate, flowers intermediate with corolla filiform, and disc flower with corolla bilabiate) (Fig. 2C) ..... *Chaptalia integerrima*
15'. Heads with flowers monomorphic or dimorphic.
16. Plants dioecious.
17. Heads forming a leafy raceme of glomerule; leaf blade linear ..... *Baccharis linearifolia*
17'. Capitulescence corymbiform, paniculiform or panicle-corymbiform; leaf blade elliptic, spatulate, lanceolate, oblanceolate, obovoid or orbicular.
18. Leaves trinerved.
19. Stems and leaves cinereous-tomentose (Fig. 5B) ..... *Baccharis cinerea*
19'. Stems and leaves glabrous ..... *Baccharis trinervis*
18'. Leaves penninerved.
20. Leaf blade tomentose in the abaxial surface with white to cinereous trichomes and glabrescent in the adaxial surface, apex acute to acuminate ..... *Baccharis calvescens*
20'. Leaf blade glabrous, viscid, apex rounded or obtuse.
21. Heads solitaries in the axil of the stems ..... *Baccharis reticularia*

21'. Capitulescence in panicle-corymbiform.
22. Leaf blade spatulate to oblanceolate, margin dentate, base cuneate; heads in glomerule sessile or subsessile ..... *Baccharis retusa*
22'. Leaf blade ovate or obdeltade, margin entire or denticlate, base atenuate; heads in glomerule pedicellate ..... *Baccharis alleluia*
16'. Plants monoecious or gynodioecious.
23. Leaves opposite.
24. Heads with 4 involucral bracts and 4 flowers, 5 involucral bracts and 5 flowers or 2 involucral bracts and 4 flowers.
25. Heads with 2 flowers pistillate and 2 flowers bisexual and 2 involucral bracts ..... *Synedrellopsis grisebachii*
25'. Heads with all flowers bisexual and 4 or 5 involucral bracts.
26. Heads with 5 involucral bracts and 5 flowers.
27. Leaf blade coriaceous, glabrous, margin entire ..... *Hoehnephytum almasense*
27'. Leaf blade membranaceous, adaxial face with glandular trichomes stipitate and abaxial face with sessile glandular trichomes, margin crenate ..... *Stevia morii*
26'. Heads with 4 involucral bracts and 4 flowers.
28. Cypsela 10-costate (Fig. 8H) ..... *Mikania grazielae*
28'. Cypsela 5-costate.
29. Leaf blade ovate, margin dentate.
30. Leaf blade with apex obtuse, base oblique to rounded; capitulescence thyrsoid ..... *Mikania phaeoclados*
30'. Leaf blade with apex acute, base hastate; capitulescence glomeruliform ..... *Mikania glomerata*
29'. Leaf blade elliptic or cordiform, margin entire or crenulate.
31. Leaf blade elliptic, apex acuminate, margin entire, revolute, base attenuate (Fig. 8G) ..... *Mikania elliptica*
31'. Leaf blade cordiform, apex acute, margin crenulate, sinuate, base cordate.
32. Hexagonal branches; capitulescence corymbiform ..... *Mikania cordifolia*
32'. Cylindrical branches; capitulescence glomeruliform (Fig. 8F) ..... *Mikania congesta*
24'. Heads with 5 or more involucral bracts and 4 or more flowers.
33. Leaf blade with venation subparallel; involucral bracts and paleae with cartaceous and sinuous appendices at apex (Fig. 8J) ..... *Scherya bahiensis*
33'. Leaf blade with venation penninerved or acrodromous; involucral bracts and paleae without cartaceous and sinuous appendices at apex.
34. Receptacle paleaceous; pappus aristate, coroniform, coroniform-aristate or absent.
35. Pappus aristate (2 to 5 caducous awns) or absent.
36. Leaf blade lanceolate, conduplicate, apex caudate, margin serrate, base attenuate (Fig. 7G) ..... *Acritopappus confertus*
36'. Leaf blade elliptic to obovate, flat, apex obtuse to apiculate, margin serrulate, base rounded (Fig. 7I) ..... *Acritopappus prunifolius*
35'. Pappus coroniform.
37. Heads with 20-26 flowers; 15-21 paleae in the receptacle (Fig. 7H) ..... *Acritopappus heterolepis*
37'. Heads with 5-8 flowers; 1-2 paleae in the receptacle.
38. Leaf blade deltoid to ovate (Fig. 7J) ..... *Acritopappus santosii*
38'. Leaf blade elliptic ..... *Acritopappus* sp. nov.
34'. Receptacle epaleaceous; pappus of bristle, bristle-barbelate or paleaceous-aristate.
39. Heads with 58-75 flowers; pappus with 5 awn-tipped scales (Fig. 7K) ..... *Ageratum conyzoides*
39'. Heads with 4 to 28 flowers; pappus of bristle or bristle-barbelate.
40. Involucre strongly imbricate with 30-36 involucral bracts, deciduous.
41. Leaf blade elliptic, apex acute, margin entire ..... *Chromolaena morii*
41'. Leaf blade ovate, apex caudate, margin dentate (Fig. 8B) ..... *Chromolaena maximilianii*
40'. Involucre imbricate with 7-20 involucral bracts, persistent.
42. Cypsela obconical with vesicular trichomes; pappus biseriate (Fig. 8L) ..... *Symphyopappus decussatus*

42'. Cypsela cylindrical without vesicular trichomes; pappus uniseriate.
43. Shrub 0.5 m alt.; leaves arranged along the stem; leaf blade ovate, apex acuminate to caudate, base cordate (Fig. 8D) ..... *Koanophyllon conglobatum*
43'. Shrub 3-4 m alt.; leaves congested at the apex of the stem; leaf blade orbicular to obovate, apex rounded to truncate, base cuneate to truncate (Fig. 8E) ..... *Lapidia apicifolia*
23'. Leaves alternate.
44. Receptacle deeply alveolate involving the cypsela (Fig. 3B) ..... *Albertinia brasiliensis*
44'. Receptacle alveolate, not involving the cypsela.
45. Connective appendage of the anther apiculate; style branches short and glabrous.
46. Plants monoecious, subshrubs; pappus uniseriate (Fig. 2F) ..... *Richterago discoidea*
46'. Plants gynodioecious, shrubs or trees; pappus 2-3-seriate.
47. Capitulescence smaller than leaves (Fig. 2H) ..... *Moquiniastrum oligocephalum*
47'. Capitulescence larger than leaves (Fig. 2G) ..... *Moquiniastrum blanchetianum*
45'. Connective appendage of other formats; style branches long, with trichomes or papillate.
48. Leaf blade pinnatipartite ..... *Artemisia vulgaris*
48'. Leaf blade entire or lyrate-pinnatifid at the base.
49. Heads with disc flowers with corolla tubular and bisexual or functionally staminate and flower at the margin with corolla tubular-filiform and pistillate.
50. Stems cylindrical; involucre calyculate ..... *Erechtites hieracifolius*
50'. Stems alate; involucre ecalyculate.
51. Leaf blade strongly discolorous; heads grouped in spike of glomerules ..... *Pterocaulon alopecuroides*
51'. Leaf blade concolorous or slightly discolorous; capitulescence of other types.
52. Leaf blade concolorous; disc flowers bisexual.
53. Plant with few ramification (up to 3) and branches with few heads; leaf blade with base lyrate-pinnatifid..... *Conyza primulifolia*
53'. Plant with many ramification (8 or more) and branches with many heads; leaf balde with base entire ..... *Conyza sumatrensis*
52'. Leaf blade slightly discolorous; disc flowers functionally staminate.
54. Pappus of bristles (Fig. 5D) ..... *Pluchea sagittalis*
54'. Pappus absent ..... *Epaltes brasiliensis*
49'. Head with all flowers with corolla tubular and bisexual.
55. Head with involucre uniseriate.
56. Subshrub or shrub; leaf blade lanate on the adaxial face and albo-tomentose on the abaxial face; flowers with corolla yellow ..... *Senecio macrotis*
56'. Herb; leaf blade glabrous to sparsely pubescent on both faces; flowers with corolla red (Fig. 5E) ..... *Emilia fosbergii*
55'. Head with involucre bi to multiseriate.
57. Capitulescence double racemiform; style branches minutely bifid, distal portion swollen papillate below the bifurcation (Fig. 4I) ..... *Moquinia racemosa*
57'. Solitary heads or capitulescence umbelliform, corymbiform, glomeruliform, paniculiform or cymose-scorpioid; style branches long, cylindrical, papillate or pilose below bifurcation and apex obtuse or clavate, or pilose extending below the bifurcation and apex acute.
58. Style branches papillate or pilose below bifurcation , apex obtuse or clavate.
59. Receptacle paleaceous (1–2 pales); style branches pilose below the bifurcation.
60. Leaf sessile to subpetiolate (c. 0.2 cm long), leaf blade 0.8–1.5 cm long ..... *Stylotrichium corymbosum*
60'. Leaf petiolate (1.3–1.5 cm long), leaf blade 0.4–0.5 cm long (Fig. 8K) ..... *Stylotrichium edmundoi*
59'. Receptacle epaleaceous; style branches with papillae above the bifurcation.
61. Corolla lobes densely pubescent; cypsela stipitate.
62. Leaves fasciculate and congested; leaf blade obovate (Fig. 8O) ..... *Trichogonia tombadorensis*
62'. Leaves lax; leaf blade narrow-elliptic, oblanceolate, lanceolate or triangular.

63. Leaf blade 0.8–1.7 × 0.4–0.7 cm, narrow-elliptic or oblanceolate, base attenuate (Fig. 8M) .... *Trichogonia campestris*
63'. Leaf blade 2.5–7 × 1–3 cm, lanceolate or triangular, base truncate (Fig. 8N) .... *Trichogonia salviifolia*
61'. Corolla lobes glabrous or with trichome glandular-punctate; cypsela cylindrical.
64. Leaf sessile, leaf blade linear, margin entire.
65. Involucral bracts 22, 2–4 seriate; receptacle convex or conical, paleaceous; flowers with corolla lilac to pink (Fig. 7L) ..... *Agrianthus empetrifolius*
65'. Involucral bracts 12–14, 5 seriate; receptacle flat, epaleaceous; flowers with corolla cream (Fig. 8I) ..... *Pseudobrickellia brasiliensis*
64'. Leaf petiolate, leaf blade obovate, ovate, lanceolate, elliptic, margin crenate, dentate or serrate in the upper 1/3.
66. Plants viscid; leaf blade concolour, margin serreate in the upper 1/3; cypsela glabrous (Fig. 7M) ..... *Bahianthus viscosus*
66'. Plants not viscid; leaf blade discolorous, margin dentate or crenate; cypsela pilose or with glandular punctate or stipitate trichome.
67. Leaf blade with margin dentate and base oblique; corolla with papillae projections inside the lobes ..... *Prolobus nitidulus*
67'. Leaf blade with margin crenate and base truncate; corolla glabrous inside the lobes.
68. Heads with 4–5 flowers, corolla white to pink; receptacle flat (Fig. 8A) .... *Bejaranoa semistriata*
68'. Heads with 25–35 flowers, corolla lilac; receptacle conical (Fig. 8C) .... *Conocliniopsis prasiifolia*
58'. Style branches pilose below bifurcation, apex acute.
69. Scandent shrub; quadrangular stems; leaf blade of the abaxial face densely lepidote with translucent gland ..... *Piptocarpha leprosa*
69'. Erect herb, subshrub, shrub or tree; terete stems; leaf blade without indumentum lepidote and translucent glands.
70. Plants with leaf-rosette, internode congested and involucre 2-seriate.
71. Leaf blade oblanceolate to obovate; bracts cordiform at the base of the head; pappus uniseriate ..... *Elephantopus mollis*
71'. Leaf blade lanceolate; bracts narrow lanceolate at the base of the head; pappus biseriate .. .. *Elephantopus hirtiflorus*
70'. Plants not rosulate, internode spaced and involucre 3-8-seriate.
72. Head with 1-4 flowers; pappus 3-5-seriate.
73. Heads 2–5 per glomerule; 3 flowers per head (Fig. 3H) ..... *Eremanthus capitatus*
73'. Heads 75–105 per glomerule; 1 flower per head (Fig. 3I) .... *Eremanthus glomerulatus*
72'. Heads with 5 or more flowers; pappus biseriate.
74. Heads pedunculate of second order in glomerule, retted with age.
75. Leaf sessile, with base auriculate (Fig. 4C) .... *Paralychnophora reflexoauriculata*
75'. Leaf petiolate, base cuneate ..... *Paralychnophora harleyi*
74'. Heads pedunculate or sessile in other types of capitulescence, erect.
76. Stems fistulous; leaf blade pinnaripartite, sheathing (Fig. 3E) .... *Chresta pacourinoides*
76'. Stems not fistulous; leaf blade entire, not amplexicaul.
77. Leafy bracts surrounding the head; receptacle alveolate-aristate.
78. Heads with ca. 150 flowers; apex of involucral bracts aristate (Fig. 3D) .... *Centratherum punctatum*
78'. Heads with 24–60 flowers; apex of involucral bracts acute, acuminate or apiculate.
79. Leaf blade ovate to orbicular, margin dentate (Fig. 4E) .... *Stilpnopappus* sp. nov.
79'. Leaf blade elliptic, lanceolate, narrow-lanceolate or linear, margin entire.

80. Subshrub with decumbent branches; leaf blade with base attenuate (Fig. 4D) .... *Stilpnopappus semirianus*
80'. Subshrub with erect branches; leaf blade with base cuneate or semi-amplexicaul.
81. Leaf blade flat, apex acuminate, base cuneate ..... *Stilpnopappus suffruticosus*
81'. Leaf blade conduplicate, apex acute, base semi-amplexicaul .... *Stilpnopappus tomentosus*
77'. Heads without leafy bracts at the base; receptacle flat, fimbriate, alveolate without aristae.
82. Capitulescence glomeruliform; leaf blade with stellate and glandular-punctate trichomes on both faces (Fig. 3C) ..... *Blanchetia heterotricha*
82'. Capitulescence paniculiform, raceme-corymbiform or cymose-scorpioid; leaf blade without stellate and glandular-punctate trichome
83. Shrub and tree; capitulescence in pyramidal panicle.
84. Branches and venation vinaceous; leaves sessile; leaf blade narrow-elliptic .... *Vernonanthura laxa*
84'. Branches and venation without vinaceous colour; leaves petiolate; leaf blade obovate or elliptic.
85. Involucral bracts 78–80; flowers ca. 41 (Fig. 4F) .... *Vernonanthura brasiliana*
85'. Involucral bracts 22–62; flowers 11-27.
86. Involucre 5-seriate; flowers 11–13, corolla pink to white (Fig. 4H) .... *Vernonanthura subverticillata*
86'. Involucre 7-9-seriate; flowers 25–27, corolla cream (Fig. 4G) .... *Vernonanthura polyanthes*
83'. Subshrub to shrub; capitulescence in cymose-scorpioid.
87. Heads arranged in two series (subduplicate) in the flowering branches.
88. Leaf blade oblong to ovate, apex obtuse to rounded, margin crenulate to denticulate, base rounded, abaxial face lanate (Fig. 3F) .... *Cyrtocymura harleyi*
88'. Leaf blade lanceolate, apex acute, mucronate or acuminate, margin entire to denticulate, base attenuate, abaxial face pubescent to sericeous (Fig. 3G) .... *Cyrtocymura scorpioides*
87'. Heads in the one series in the flowering branches.
89. Cypsela pubescent, without glandular-punctate .... *Lessingianthus morii*
89'. Cypsela sericeous, tomentose or setose, glandular-punctate.
90. Plants with angulate branches.
91. Leaf blade with adaxial face strigose with glandular sessile trichomes and abaxial face albo-tomentose (Fig. 3M) .... *Lepidaploa cotoneaster*
91'. Leaf blade puberulous with glandular sessile trichomes on both faces (Fig. 3K) ..... *Lepidaploa bahiana*
90'. Plants with cylindrical branches.
92. Leaf blade closely linear, concolorous (Fig. 4B) .... *Lepidaploa tombadorensis*
92'. Leaf blade ovate, deltoid, lanceolate, elliptic, discolorous.
93. Leaf blade ovate to deltoid; flowers 34–39 per head (Fig. 3J) .... *Lepidaploa aurea*
93'. Leaf blade elliptic to ovate; flowers 10–21 per head.
94. Leaf blade 0.6–2.1 × 0.5–1.4 cm; cypsela densely sericeous (Fig. 3L) ..... *Lepidaploa chalybaea*
94'. Leaf blade 2.6–7.4 × 1.5–3.5 cm; cypsela tomentose (Fig. 4A) .... *Lepidaploa lilacina*

1'. Radiate head (2 corolla types: liguliform at margin and tubulose in the disc).

95. Leaves alternate or upper alternate and lower opposite.
96. Leaves and involucral bracts with glandular and aromatic pockets (dark spots or lines); involucre uniseriate (Fig. 7C) ..... *Tagetes minuta*
96'. Leaves and involucral bracts without glandular and aromatic pockets; involucre 2–4 seriate.
97. Receptacle epaleaceous; pappus coroniform inconspicuous (Fig. 5C) ..... *Egletes viscosa*
97'. Receptacle paleaceous; pappus coroniform (c. 2 mm long.), aristate or paleaceous.
98. Floral peduncle fistulous; pappus coroniform.
99. Involucre 3-4-seriate, the inners with apex rounded or obtuse, corolla yellow (Fig. 6C) ..... *Tithonia diversifolia*
99'. Involucre biseriate, the inner with apex acuminate, corolla orange (Fig. 6D) ..... *Tithonia rotundifolia*
98'. Floral peduncle not fistulous; pappus aristate.
100. Ray flowers neutral; cypsela with confined embryo in the center and flat border around ... *Simsia dombeyana*
100'. Ray flowers pistillate; cypsela alate.
101. Leaf blade lobed, margin dentate; flowers with corolla white (Fig. 6F) ..... *Verbesina macrophylla*
101'. Leaf blade entire, margin serrate at 2/3 upper; flowers with corolla yellow (Fig. 6E) ..... *Verbesina glabrata*
95'. All leaves opposite.
102. Pappus absent or insconspicuous (c. 0.1 mm long.).
103. Receptacle conical.
104. Involucre subglobose, 2-seriate with 9–11 involucral bracts ..... *Acmella ciliata*
104'. Involucre campanulate, uniseriate with 5–6 involucral bracts (Fig. 5H) ..... *Acmella uliginosa*
103'. Receptacle flat or convex.
105. Cypsela with uncinate prickles.
106. Leaf blade rhombic-ovate; cypsela subcylindrical with uncinate prickles of the same size (Fig. 7D) ..... *Acanthospermum australe*
106'. Leaf blade obtrullate-obovate; cypsela obpyramidal compressed with uncinate prickles of the same size and two larger rigid awns at apex (Fig. 7E) ..... *Acanthospermum hispidum*
105'. Cypsela without uncinated prickles.
107. Head with 2 flowers and 3 involucral bracts (Fig. 5L) ..... *Delilia biflora*
107'. Head with 15 or more flowers and more than 5 involucral bracts.
108. Head sessile; cypsela striate (Fig. 5F) ..... *Enydra radicans*
108'. Head pedunculate; cypsela smooth or tuberculate.
109. Peduncle fistulous; involucral bracts 5–6-seriate, apex rounded with dark blue or blackish line (Fig. 6H) ..... *Zinnia elegans*
109'. Peduncle not fistulous; involucral bracts 2-seriate, apex acute or acuminate without dark blue or blackish line.
110. Flowers 78–110; cypsela oblanceoloid or obovoid (bacaceous aspect), smooth (Fig. 6B) ... *Tilesia baccata*
110'. Flowers c. 15; cypsela triquetrous or obpyramidal, tuberculate ..... *Baltimora geminata*
102'. Pappus coroniform, coroniform-aristate, aristate, scale, plumose or bristle.
111. Leaf blade pinnatisect; cypsela fusiform (Fig. 6I) ..... *Bidens pilosa*
111'. Leaf blade entire; cypsela obconical, obpyramidal, obovoid or oblanceoloid.
112. Ray corolla linear; receptacle with paleae filiform (Fig. 5M) ..... *Eclipta prostrata*
112'. Ray corolla elliptic or narrow elliptic; receptacle with paleae linear, lanceolate, ovate or narrowly- lanceolate.
113. Pappus plumose or bristle.
114. Prostrate herb; ray flowers white; pappus plumose and persistent (Fig. 7F) ..... *Tridax procumbens*
114'. Erect herb; ray flowers yellow; pappus of bristle and deciduous (Fig. 6A) ..... *Melanthera latifolia*
113'. Pappus coroniform, coroniform-aristate, aristate or paleaceous.
115. Involucral bracts striate.
116. Corolla white; receptacle flat; pappus aristate (Fig. 5K) ..... *Blainvillea acmella*
116'. Corolla yellow; receptacle conical; pappus of scales (Fig. 5G) ..... *Calea candolleana*
115'. Involucral bracts no striate.
117. Ray flowers neutral; cypsela with basal scar.
118. Leaves sessile, chartaceous, leaf blade linear or lanceolate (Fig. 5I) ..... *Aspilia martii*
118'. Leaves short-petiolate (petiole up to 0.2 cm long), coriaceous, leaf blade narrowly-elliptic or elliptic (Fig. 5J) ..... *Aspilia subalpestris*
117'. Ray flowers pistillate; cypsela without basal scar (Fig. 6G) ..... *Wedelia goyazensis*

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