



Comparative analysis of red lists of the Brazilian flora: Asteraceae

Análise comparativa das listas vermelhas da flora do Brasil: Asteraceae

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Abstract

Asteraceae is one of the most abundant families of the Brazilian flora, and it stands out on Brazilian red lists due to the large number of endangered and data-deficient species, since it is difficult to define a conservation status for the latter. A comparative analysis of red lists of the Brazilian flora focused on the Asteraceae is important, so we can assess the true degree of threat to which these plants are subjected faced with increasing environmental degradation. Our analysis compared red lists, and pointed out the most threatened species or data-deficient areas, species and genera. The study was based on the first and the current Official List of Endangered Species of the Brazilian Flora, and the Brazilian Flora Red List of Fundação Biodiversitas. Species were organized according to the endangered and data-deficient IUCN categories. Endangered species were also classified according to threat category. The highest numbers of threatened species were observed in the Cerrado, in the southeastern region, and in the state of Minas Gerais, as well as in the genera *Lychnophora* Mart., *Vernonia* Schreb., and *Richterago* Kuntze. The genera *Aspilia* Thouars, *Baccharis* L., *Calea* L., *Eupatorium* L., *Mikania* Willd., *Piptocarpha* R.Br., and *Senecio* L. have the greatest number of data-deficient species. Since the current Official List does not make clear its threat criteria, the Red List of Fundação Biodiversitas best portrays the situation of endangered Asteraceae species; thus, this analysis provides important information for projects aimed at the conservation of threatened and data-deficient species.

Key words: Asteraceae, threatened brazilian flora, plant red list.

Resumo

A família Asteraceae é de grande representatividade na composição florística do Brasil, e se destaca nas listas da flora ameaçada brasileira devido ao grande número de espécies ameaçadas e com ausência de dados que permita uma definição do *status* de conservação. A análise comparativa das Listas Vermelhas da Flora do Brasil para Asteraceae é de importância para caracterizar o verdadeiro grau de ameaça das suas espécies diante do crescente processo de degradação ambiental. O estudo estabelece as diferenças dessas listas e diagnostica as áreas e os gêneros mais ameaçados e/ou deficientes em dados. A análise foi baseada na Primeira Lista Oficial da Flora Brasileira, na Revisão da Lista realizada pela Fundação Biodiversitas e na Lista Oficial Atual. Os dados foram organizados em espécies ameaçadas e deficientes em dados, e foram quantificados por gênero e número de espécies. As espécies ameaçadas foram quantificadas também por categoria de ameaça. O Cerrado, a Região Sudeste, o estado de Minas Gerais e os gêneros *Lychnophora* Mart., *Richterago* Kuntze e *Vernonia* Schreb. possuem os maiores números de espécies ameaçadas, e *Aspilia* Thouars, *Baccharis* L., *Calea* L., *Eupatorium* L., *Mikania* Willd., *Piptocarpha* R.Br. e *Senecio* L. possuem os maiores números de espécies deficientes em dados. Pela não divulgação dos critérios da Lista Oficial atual, a Lista Vermelha da Fundação Biodiversitas reflete melhor a situação de ameaça das espécies de Asteraceae no Brasil. Portanto, é um importante instrumento de subsídio aos projetos para a preservação de espécies ameaçadas e deficientes em dados.

Palavras-chave: Asteraceae, flora brasileira ameaçada, lista vermelha da flora.

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Introduction

While exploiting nature for its own subsistence, mankind has caused intense environmental degradation, converting continuous forests into fragments (Scariot *et al.* 2003). Estimates point out between 13 and 14 millions of animal and plant species on Earth, out of which only 13 % have been identified so far. Hence, the risk of losing a large number of still unknown species is high, and warns us against increasing ecosystem alteration (Fundação Biodiversitas 2007a). In addition, estimates indicate that between 5 and 20% of the already identified plant and animal species will be endangered in the near future if protective measures are not urgently taken (Fundação Biodiversitas 2007a).

One of the greatest challenge for governments is the definition of strategic plans for biodiversity conservation, considering the scarcity of biological information for most species (Fundação Biodiversitas 2010), since human activity may imply environmental degradation and compromise species survival (Fundação Biodiversitas & Fundação Zoobotânica de Belo Horizonte 2000). However, strategies to reverse threats to species begin by assessing their conservation status throughout scientific criteria (Fundação Biodiversitas 2007a). The elaboration of red lists of fauna and flora is the basic tool for defining conservation status (Fundação Biodiversitas 2007a).

Red lists are a legal tool for the protection of endangered species, informing and warning governments, conservationists, and the general public about the increasing degradation of the genetic patrimony worldwide (Fundação Biodiversitas 2010). Red lists are the backgrounds for public and private land use policies, conservation strategies (Fundação Biodiversitas 2010). Red lists are also used worldwide against illegal wildlife trade, according to the appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), of which Brazil is a signatory since 1975 (Brasil 2000).

Therefore, red lists are important tools for species conservation, since any biodiversity conservation strategy requires quantification of species and how they are distributed (Primack & Rodrigues 2001). Knowledge of species distribution and conservation status provides the basis for decisions on local and global biodiversity conservation (Marchioretto *et al.* 2005).

Brazil is considered as the most megadiverse country, with over 56,000 plant species, which correspond to 19% of the world's flora, with high

endemism rates (Giulietti *et al.* 2005; MRE & MMA 2006).

In terms of species diversity in Brazil, Asteraceae is the third richest family in number of species among angiosperms (Nakajima *et al.* 2010). Despite its recognized importance in the floristic composition of the country, the family has little prominence in the Official Lists of Endangered Species of the Brazilian Flora (IBAMA 1992; MMA 2008), due to the reduced number of species listed as endangered and to the high number of species listed as data deficient, i.e., with insufficient data for defining their conservation status.

The main objective of the present study is to make a comparative analysis of the conservation status of Asteraceae species included in red lists of the Brazilian flora, to define: a) the percentage of genera and species of this family in different degrees of threat; b) the differences between lists in the number and degree of threatened species, as well as in the criteria and categories used; c) the distribution of threat categories in Brazilian biomes, regions and states; d) the most threatened genera; e) the most data deficient genera.

Materials and Methods

The comparative analysis of threatened Asteraceae species in Brazil was based on data of the first Official List of Endangered Species of the Brazilian Flora (IBAMA 1992), the Brazilian Angiosperm Red List of Fundação Biodiversitas (Fundação Biodiversitas 2007b), and the current Official List of Endangered Species of the Brazilian Flora (MMA 2008). These lists are referred to as First Official List, Red List, and Current Official List, respectively.

The First Official List was published using the categories rare (R), vulnerable (V) and undetermined (U). This categorization was indicated by specialists, based mainly on the commercial exploitation, because at the time of its elaboration there were no standard objective criteria to judge the conservation status of a species.

The Red List was elaborated by specialists on several angiosperm families, based on the criteria and categories proposed by the International Union for Conservation of Nature (IUCN 2001, Version 3.1). The categories used were critically endangered (CR), endangered (EN), vulnerable (VU), data deficient (DD), and least concern (LC). The methodology for species assessment and details about criteria and categories can be found at the website of Fundação Biodiversitas (<www.biodiversitas.org.br>).

IUCN's criteria and categories (IUCN 2001) are organized in a widely used classification system for globally endangered species, focused on conservation measures aimed at protecting those species (IUCN 2001). These criteria and categories were submitted to a wide review in the past few years, as a result of an international effort, and are currently in the version 8.1 (IUCN 2010).

The Current Official List should be based on results of the Red List of Fundação Biodiversitas, since this foundation was responsible by the Brazilian Ministry of the Environment (MMA) for this task. However, there was no agreement between the parties; consequently, the criteria used in the Current Official List were not the same used in the Red List of Fundação Biodiversitas (Fundação Biodiversitas 2007b). Species in the Current Official List were classified as endangered (EN) or data deficient (DD).

Due to the large amount of information present in all red lists, data were organized by threatened species; quantification by genera, threatened categories and geographic distribution; quantification of data deficient species only by genera.

The results were organized in tables for better visualization, interpretation, and analysis. These analysis aimed basically at obtaining information such as the genera with the highest number of threatened species, and the genera that have the highest number of species classified as critically endangered (CR). The comparison among the three lists was aimed to diagnosing the threatened common or divergent species, as well as at comparing informations with the literature.

The genera *Eupatorium* L. and *Vernonia* Schreb. were considered in the tradicional sense, despite several genera currently considered as valid in the literature (Funk *et al.* 2009). The genus *Argyrovernonia* MacLeish, with two species, has been synonymized with *Chresta* Vell. ex DC. In this case it also followed the traditional classification, since all lists have already been published and are available online.

Results and Discussion

Lists of endangered Asteraceae of the Brazilian flora

In the First Official List, the Red List and the Current Official List, a total of 427 Asteraceae species are listed (Appendix 1). According to IUCN's criteria (IUCN 2001), out of these 427 species, 50 were categorized as least concern (11% of all species), and 212 as data deficient (49.6%),

resulting in a total of 165 threatened species (Tab. 2; Appendix 1). Since in Brazil the family Asteraceae is represented by 1,965 species of 271 genera (Nakajima *et al.* 2010), approximately 8% of the Asteraceae species are included in some category of threat in the country.

This percentage of endangered Asteraceae is high above the estimate of 3% made for all angiosperms in Brazil (Fundação Biodiversitas 2007b), showing that this family in particular can lose more species in the next few years. The same situation may be proven for other families which have a higher number of endangered species in different Brazilian biomes.

First Official List

The First Official List (IBAMA 1992) included only six Asteraceae species (Appendix 1) belonging to three genera: *Aspilia* Thouars (4 spp.), *Lomatozona* Baker (1 sp.) and *Lychnophora* Mart. (1 sp.). Among these species, two (33%) were considered as undetermined due to the lack of information on distribution and threats, thus hindering a reliable assessment of their conservation status.

Out of the four species (67%) classified as endangered, three were in the category rare (75% of the endangered species) and one was in the category vulnerable (25%). Most endangered species were included in the category rare, and among IUCN's threat categories (IUCN 2001), the category critically endangered (CR) is the most similar to the category rare, which represented the highest extinction risk in the First Official List.

Red List

The Red List (Fundação Biodiversitas 2007b) was created based on IUCN's criteria (IUCN 2001) and included 427 Asteraceae species (Appendix 1) belonging to 92 genera (Tab. 1).

The 165 endangered species included in this Red List represent 38% of all species analyzed (Tab. 2). Out of this total, 70 species were pointed out as threatened in the category CR (43% of the endangered species), 21 species as EN (13%), and 74 as VU (45%).

The 212 species included in this list (Fundação Biodiversitas 2007b) (almost 50% of all species) were considered as data deficient (DD), hindering a reliable assessment of their conservation status (Tab. 2). The lack of information about their geographic distribution and threats to their populations hinders the conservation of these species and, hence, they

Table 1 – Genera of the Asteraceae indicated in the revised Red List of Brazilian Flora (Fundação Biodiversitas 2007b) with the number of species (n) and the percentage of these genera (%) in relation to the total number of species.

Genera	n	%	Genera	n	%	Genera	n	%
<i>Acmella</i>	1	0.23	<i>Gorceixia</i>	1	0.23	<i>Piptocoma</i>	1	0.23
<i>Acritopappus</i>	3	0.7	<i>Graphistylis</i>	6	1.4	<i>Planaltoa</i>	1	0.23
<i>Ageratum</i>	2	0.47	<i>Heterocoma</i>	1	0.23	<i>Porophyllum</i>	3	0.7
<i>Agrianthus</i>	2	0.47	<i>Hieracium</i>	1	0.23	<i>Praxeliopsis</i>	1	0.23
<i>Ambrosia</i>	1	0.23	<i>Hoehnephytum</i>	2	0.47	<i>Proteopsis</i>	1	0.23
<i>Anteremanthus</i>	1	0.23	<i>Holocheilus</i>	1	0.23	<i>Pseudogynoxys</i>	1	0.23
<i>Apopyros</i>	1	0.23	<i>Hysterionica</i>	3	0.7	<i>Quelchia</i>	1	0.23
<i>Argyrovernonia</i>	2	0.47	<i>Ianthopappus</i>	1	0.23	<i>Radlkoferotoma</i>	1	0.23
<i>Aspilia</i>	27	6.31	<i>Ichthyothere</i>	6	1.4	<i>Richterago</i>	13	3.04
<i>Baccharis</i>	19	4.44	<i>Inulopsis</i>	1	0.23	<i>Schlechtendalia</i>	1	0.23
<i>Baltimora</i>	1	0.23	<i>Irwinia</i>	1	0.23	<i>Senecio</i>	23	5.37
<i>Bidens</i>	1	0.23	<i>Isocarpha</i>	1	0.23	<i>Simsia</i>	1	0.23
<i>Blainvillea</i>	1	0.23	<i>Isostigma</i>	3	0.7	<i>Smallanthus</i>	2	0.47
<i>Calea</i>	16	3.74	<i>Lasiolaena</i>	6	1.4	<i>Stenachaenium</i>	1	0.23
<i>Catolesia</i>	1	0.23	<i>Lomatozona</i>	1	0.23	<i>Stenocline</i>	4	0.93
<i>Chaptalia</i>	4	0.93	<i>Lucilia</i>	1	0.23	<i>Stenopadus</i>	4	0.93
<i>Chionolaena</i>	8	1.87	<i>Lychnophora</i>	19	4.44	<i>Stenophalium</i>	1	0.23
<i>Chresta</i>	4	0.93	<i>Lychnophoriopsis</i>	4	0.93	<i>Stevia</i>	9	2.1
<i>Chrysolaena</i>	1	0.23	<i>Mattfeldanthus</i>	1	0.23	<i>Stiffitia</i>	3	0.7
<i>Dasyphyllum</i>	7	1.63	<i>Mikania</i>	22	5.14	<i>Stilpnopappus</i>	5	1.17
<i>Dendrophorbium</i>	5	1.17	<i>Minasia</i>	4	0.93	<i>Stylotrichium</i>	5	1.17
<i>Dimerostemma</i>	9	2.1	<i>Monogereion</i>	1	0.23	<i>Symphypappus</i>	6	1.4
<i>Eleutheranthera</i>	1	0.23	<i>Moquinia</i>	2	0.47	<i>Trichocline</i>	4	0.93
<i>Eremanthus</i>	9	2.1	<i>Neblinaea</i>	1	0.23	<i>Trichogonia</i>	2	0.47
<i>Erigeron</i>	2	0.47	<i>Noticastrum</i>	3	0.7	<i>Trixis</i>	6	1.4
<i>Eupatorium</i>	18	4.2	<i>Onoseris</i>	2	0.47	<i>Verbesina</i>	1	0.23
<i>Eurydochus</i>	1	0.23	<i>Ophryosporus</i>	1	0.23	<i>Vernonia</i>	26	6.08
<i>Gardnerina</i>	1	0.23	<i>Pamphalea</i>	6	1.4	<i>Viguiera</i>	9	2.1
<i>Glossarion</i>	2	0.47	<i>Paralychnophora</i>	6	1.4	<i>Wedelia</i>	2	0.47
<i>Gochnatia</i>	8	1.87	<i>Perezia</i>	3	0.7	<i>Wunderlichia</i>	5	1.17
<i>Gongylolepis</i>	3	0.7	<i>Piptocarpha</i>	11	2.57		427	100

can be under high extinction risk. The same was also observed for all species initially assessed (5,212 species) in the Brazilian Angiosperm Red List (Fundação Biodiversitas 2007b), since 2,513 of them (48%) were considered as data deficient.

The remaining 50 species (12% of all species) included in the Red List (Fundação Biodiversitas 2007b) were classified as least concern (Tab. 2). These species were included because they were probably threatened. However, after using IUCN's criteria (IUCN 2001), they were not proven to be endangered.

Current Official List

The Current Official List (MMA 2008), contrary to the Red List (Fundação Biodiversitas 2007b), included only 168 Asteraceae species (Appendix 1) of 56 genera (Tab. 3). Among all species included in this list, only 15 species (10% of all species) were classified as endangered (Appendix 1) and considered as priority for public conservation policies in Brazil (MMA 2008). Out of these 15 species, *Anteremanthus hatschbachii* H.Rob., *Aspilia grazielae* J.U.Santos, *Aspilia pohlii* Baker, *Hysterionica pinnatisecta* Matzenb.

Table 2 – Number (n) and percentage (%) of Asteraceae species indicated in each threatened categories (TC) in the revised Red List of Brazilian Flora (Fundação Biodiversitas 2007b).

Species	TC	n	% (List)	% (threatened species)
Data deficient	Data deficient (DD)	212	49.64	
Least concern	Least concern (LC)	50	11.70	
Threatened	Critically endangered (CR)	70		42.42
	Endangered (EN)	21		12.73
	Vulnerable (VU)	74		44.85
	Threatened species (total)	165	38.64	100
Total of species		427	100	

& Sobral, *Senecio promatensis* Matzenb., *Senecio ramboanus* Cabrera, and *Viguiera corumbensis* Malme were also considered as rare (Giulietti *et al.* 2009). However, there are other rare Asteraceae species (Giulietti *et al.* 2009) and that are also other endangered species (Fundação Biodiversitas 2007b), but those were not classified by MMA (2008) as endangered, and the criteria for their exclusion were not explained.

According to Giulietti *et al.* (2009), rare species with range smaller than 10,000 km² may have low genetic variability; hence, they are more vulnerable to extinction in case of environmental changes (Primack & Rodrigues 2001). This criterion is used to justify the classification of rare species as endangered and conservation priority, considering the intensive environmental degradation in Brazil (Primack & Rodrigues 2001).

Among the eight remaining Asteraceae species classified as threatened by MMA (2008) is also *Lychnophora ericoides* Mart., locally known as ‘arnica’, whose use in popular medicine grows fast due to its analgesic, antiseptic, and healing properties, though there is no scientific evidence of its effectiveness. It is classified as vulnerable or endangered in all red lists due to commercial exploitation (Melo *et al.* 2009). In addition, *Aspilia paraensis* (Huber) J.U.Santos and *Aspilia procumbens* Baker were already included in the First Official List (IBAMA 1992), what could justify their classification as endangered.

The 152 remaining species included in the Current Official List (MMA 2008) (90% of all species) were considered as data deficient (Tab. 4), i.e, they are included in no categories of threat.

Number of species and categories of threat

Among all Asteraceae species and genera that occur in Brazil (Nakajima *et al.* 2010), only 0.3% (Tab. 5) of the species and approximately 1% of the genera have been included in the First Official List (IBAMA 1992). Although the First Official List (IBAMA 1992) was a great accomplishment for Brazilian conservation, it has a low number of species, because at the time of its elaboration there were no standard criteria for the assessment of conservation status, which were elaborated only in 1994 with the IUCN’s Red List of Threatened Species (IUCN 2010).

In the Red List (Fundação Biodiversitas 2007b) 22% of the species are at some degree of threat (Tab. 5). This significant increase in the number of species compared to the First Official list (IBAMA 1992) reflects mainly an increase in the knowledge of Asteraceae species, the use IUCN’s criteria (IUCN 2001), and the participation of an expressive part of the scientific community in the elaboration of the list, making it more reliable, objective, and likely to reach its goals.

In the Current Official List (MMA 2008), approximately 8.5% of the species and 20.5% of the genera are classified as endangered (Tab. 5). This reduction in the number of indicated species compared to the Red List (Fundação Biodiversitas 2007b) was not discussed by MMA (2008).

The Current Official List (MMA 2008) should have been based on the Red List (Fundação Biodiversitas 2007b) and should also have presented the same results, but there was no agreement between the parties. Hence, out of a group of 1,495

Table 3 – Genera of Asteraceae indicated in the current Official List of Endangered Species of Brazilian Flora (MMA 2008) with the number of species (n) and the percentage of these genera (%) in relation to the total number of species.

Genera	n	%	Genera	n	%	Genera	n	%
<i>Acritopappus</i>	3	1.8	<i>Ianthopappus</i>	1	0.6	<i>Richterago</i>	13	7.7
<i>Agrianthus</i>	2	1.2	<i>Ichthyothere</i>	2	1.2	<i>Schlechtendalia</i>	1	0.6
<i>Anteremanthus</i>	1	0.6	<i>Isostigma</i>	1	0.6	<i>Senecio</i>	7	4.1
<i>Aspilia</i>	5	2.9	<i>Lomatozona</i>	1	0.6	<i>Smallanthus</i>	2	1.2
<i>Baccharis</i>	5	2.9	<i>Lychnophora</i>	10	5.9	<i>Stenopadus</i>	4	2.4
<i>Calea</i>	4	2.4	<i>Lychnophoriopsis</i>	2	1.2	<i>Stenophalium</i>	1	0.6
<i>Catolesia</i>	1	0.6	<i>Mikania</i>	6	3.5	<i>Stevia</i>	5	2.9
<i>Chaptalia</i>	3	1.8	<i>Minasia</i>	2	1.2	<i>Stiffitia</i>	1	0.6
<i>Chionolaena</i>	1	0.6	<i>Monogereion</i>	1	0.6	<i>Stilpnopappus</i>	5	2.9
<i>Dendrophorbium</i>	2	1.2	<i>Neblinaea</i>	1	0.6	<i>Stylotrichium</i>	4	2.4
<i>Dimerostemma</i>	7	4.1	<i>Noticastrum</i>	3	1.8	<i>Symphypappus</i>	3	1.8
<i>Eremanthus</i>	3	1.8	<i>Ophryosporus</i>	1	0.6	<i>Trichocline</i>	2	1.2
<i>Eupatorium</i>	2	1.2	<i>Pamphalea</i>	2	1.2	<i>Trixis</i>	1	0.6
<i>Gardnerina</i>	1	0.6	<i>Paralychonophora</i>	6	3.5	<i>Verbesina</i>	1	0.6
<i>Gochnatia</i>	1	0.6	<i>Perezia</i>	2	1.2	<i>Vernonia</i>	14	8.3
<i>Heterocoma</i>	1	0.6	<i>Planaetia</i>	1	0.6	<i>Viguiera</i>	9	5.3
<i>Hoehnephytum</i>	1	0.6	<i>Porophyllum</i>	1	0.6	<i>Wedelia</i>	1	0.6
<i>Holocheilus</i>	1	0.6	<i>Proteopsis</i>	1	0.6	<i>Wunderlichia</i>	3	1.8
<i>Hysterionica</i>	2	1.2	<i>Quelchia</i>	1	0.6	Total	168	100

Table 4 – Number (n) and percentage (%) of Asteraceae species indicated in each threatened categories (TC) in the current Official List of Endangered Species of Brazilian Flora (MMA 2008).

Species	TC	TC of Red List	n	% (List)	% (threatened species)
Data deficient	DD		152	90.47	
Threatened	AM	Critically endangered (CR)	8	9.46	53.33
		Endangered (EN)	1		6.66
		Vulnerable (VU)	5		33.33
		Data deficient (DD)	1		6.66
		Threatened species (total)	15		100
Total of species			168	100	

Table 5 – Comparison between the three Red Lists of Brazilian Flora.

IBAMA (1992)	Fundação Biodiversitas (2007c)	MMA (2008)
Scientific criteria not mentioned	Scientific criteria of IUCN (2001)	Scientific criteria not mentioned
6 (0,3% of Asteraceae species)	427 (22% of Asteraceae species)	168 (8,5% of Asteraceae species)
-	50 Least concern	-
4 Threatened: 3 (R); 1 (V)	165 Threatened: 70 (CR); 21 (EN); 74 (VU)	15 Threatened: 8 (CR); 1 (EN); 5 (VU); 1 (DD)
2 Indetermined	212 Data deficient	152 Data deficient

angiosperm species classified as endangered in the total Brazilian Angiosperm Red List (Fundação Biodiversitas 2007b), only 472 (31%) were officially considered as endangered by MMA in the Current Official List (MMA 2008).

For Asteraceae, in particular, out of the 165 endangered species included in the Red List (Fundação Biodiversitas 2007b) only 15 were considered as threatened in the Current Official List (MMA 2008), i.e., 90% of the species were removed from threatened categories (Tab. 5).

The 168 Asteraceae species included in the Current Official List (MMA 2008) are also present in the Red List (Fundação Biodiversitas 2007b). However, only 18 species (11.24%) retained an equivalent conservation status. The other 150 species (88.76%) had their conservation status changed to DD in the Current Official List (MMA 2008). Among them, 61 species (41%) were transferred from CR to DD, 20 (13%) were transferred from EN to DD, and 69 (46%) were transferred from VU to DD. These 150 species diagnosed as endangered in the Red List (Fundação Biodiversitas 2007b) and as data deficient in the Current Official List (MMA 2008) are under the risk of extinction due to the lack of protective measures (Fundação Biodiversitas 2007b).

The most modified category of threat was VU, with 46% of the species having their conservation status modified to DD (MMA 2008). However, what is most disturbing is that 40% of the CR species were considered as DD by MMA (2008). The criteria used by MMA (2008) to change the conservation status of these species was not explained, and only a lack of information on the species was reported (Portal Ecodebate 2008).

Besides, the species that were included in the Red List (Fundação Biodiversitas 2007b) but

not in the Current Official List (MMA 2008) were considered as least concern by MMA (2008), summing up 209 species, excluding the 50 species that were already pointed out as LC in the Red List (Fundação Biodiversitas 2007b). The criteria used in this assessed were not made public either.

All Asteraceae species included in the First Official List (IBAMA 1992) were also included in the Red List (Fundação Biodiversitas 2007b) and in the Current Official List (MMA 2008). Most species retained their conservation status, except for *Aspilia pohlii* Baker, which had its status modified from DD to EN in the Current Official List (MMA 2008). The criterion used in this change, as previously said, is unknown, since in the Red List (Fundação Biodiversitas 2007b) this species was classified as DD based in scientific criteria. The species *Lomatozona artemisiifolia* Baker also had its conservation status changed from EN (IBAMA 1992) to DD in the subsequent lists (Appendix 1). This change can be related to the lack of knowledge on this species.

In all three lists (IBAMA 1992; Fundação Biodiversitas 2007b; MMA 2008), the category with the highest number of species was DD (Tab. 5, Appendix 1), and the highest number of species was observed in the categories CR and VU (Tab. 5, Appendix 1). These results suggest that, in addition to public policies for biodiversity conservation, studies on species with scarcity of knowledge, as well as the publications resulting from these studies, should be made priority.

Based on this comparative analysis, it is evident that the Red List is the one that better portrays the degree of threat to Asteraceae species in Brazil. Thus, we suggest the use of this list instead the Current Official List (MMA 2008) for conservation purposes.

Distribution of the endangered species in the biomes

In the First Official List (IBAMA 1992), the endangered species were distributed in the biomes Amazon (25%), Atlantic Forest (25%), and Cerrado (50%).

In the Red List (Fundação Biodiversitas 2007b), the endangered species were distributed in all Brazilian biomes (Tab. 6 and Appendix 2). The biome in which most endangered species were distributed was the Cerrado, with ca. 64% of the species (Tab. 6). It is worth mentioning that rocky highlands fields, known as “campos rupestres” are within this domain and have a high number of endemic species, in particular of Asteraceae (Giulietti *et al.* 2005). Besides, most species of this family occur mainly in open vegetations (Funk *et al.* 2009).

Although other biomes have not so many endangered species as the Cerrado, the Atlantic Forest has 12% of all endangered species, and the Pampas 13% (Tab. 6). Thus, they also deserve attention in public conservation policies, since

environmental degradation rates in these domains are also high (Fundação Biodiversitas 2007b).

Brazil is considered as one of the most megadiverse countries in the world, but threats to its wildlife and natural landscapes are dramatic (Giulietti *et al.* 2005). In general, the Cerrado is the domain where most endangered Asteraceae species are distributed (Tab. 7), since this family is very frequent in this domain (Ribeiro *et al.* 2008), which has been under strong anthropic pressure (MMA 2007).

The Cerrado is one of the main biodiversity regions in the world and covers approximately 25% of the Brazilian territory (MMA 2007). It is the second largest Brazilian biome and is located within twelve states (Torres *et al.* 2007). Vegetation in this domain varies greatly, both in number of species and in number of vegetation formations (Ribeiro & Walter 1998).

The degree of endemism in the Cerrado is also high, and little is known about the distribution of species in the domain, though important research efforts have been started in the 1980's (Primack & Rodrigues 2001). It is estimated that over 40% of the Cerrado's woody plant species are endemic (MMA 2007), and it is the richest savanna vegetation in plant diversity in the world (Brandon *et al.* 2005).

However, human occupation and road construction turned this previously continuous biome into a set of fragmented landscapes, composed of islands inserted in matrices of agroecosystems (MMA 2007). Pastures and plantations are the two most frequent land use regimes, occupying 26 and 10% of the Cerrado, respectively (Sano *et al.* 2008). Approximately 70% of the Cerrado has already lost its natural vegetation (Torres *et al.* 2007).

The intensive anthropogenic transformation of the Cerrado may result in great biodiversity loss, mainly because of the small number of protected areas and concentrated in few regions (MMA 2007). Hence, the Cerrado, together with the Atlantic Forest, is considered as one of the world's biodiversity hotspots, i.e., one of the richest and most threatened biomes of the planet (MMA 2007). The Cerrado biome received for a long time low conservation priority (Primack & Rodrigues 2001), and therefore is almost deprived of conservation unities as national parks or reserves (Drummond *et al.* 2009).

Hence, floristic studies are urgent, since a better comprehension of the distribution and diversity of its vegetation will help define priority areas for conservation of the Cerrado (Brandon *et al.* 2005).

Table 6 – Distribution in Brazilian phytogeographical domains of threatened Asteraceae species indicated in the revised Red List of Brazilian Flora (Fundação Biodiversitas 2007b).

Domain	spp.	%
Amazon	8	4.85
Caatinga	11	6.67
Pampas	22	13.33
Cerrado	105	63.64
Atlantic Forest	20	12.12
Pantanal	4	2.42

Table 7 – Percentage of threatened Asteraceae species in the “cerrado” domain in all three lists.

IBAMA (1992)	Fundação Biodiversitas (2007c)	MMA (2008)
50% of species	Ca. de 64% of species	Ca. 37% of species
MMA (2008)		Ca. 37% of species

In the Current Official List (MMA 2008), the biomes where most endangered species are distributed are Cerrado (5 species or 33%), Pampas (4 species or 26%) and Atlantic Forest (4 species or 26%) (Tab. 8). The other biomes do not have a large number of endangered Asteraceae species.

Distribution of endangered species in Brazilian states

In the First Official List (IBAMA 1992), the endangered species were distributed in the states of Goiás (two species), Minas Gerais, Pará, Rio Grande do Norte and São Paulo (one species each). In this list (IBAMA 1992) the southeastern and midwestern regions exhibited the highest number of endangered Asteraceae (2 species each), followed by the northern and northeastern regions (one species each).

In the Red List (Fundação Biodiversitas 2007b), the endangered species were distributed in 20 states (Appendix 2). The state of Minas Gerais (53 species) exhibited the highest number of endangered species (53), followed by the states of Bahia (41), Rio Grande do Sul (25), Goiás (16), Paraná (10), Santa Catarina (8), São Paulo (7), Mato Grosso do Sul (7), Roraima (4), and Rio de Janeiro (3). In each of the other states (Pará, Amazonas, Pernambuco, Piauí, Mato Grosso, Distrito Federal, Rio Grande do Norte, Espírito Santo, Ceará, Rondônia) there were only one or two endangered species. The southeastern region exhibited the highest number of endangered Asteraceae species (80 species), followed by the northeastern (47), southern (43), midwestern (11), and northern regions (9). Minas Gerais, Bahia and Rio Grande do Sul are the states with the highest number of endangered species.

In the Current Official List (MMA 2008), the endangered species are distributed in 11 states, standing out the states of Minas Gerais (5 species) and Rio Grande do Sul (4 species), followed by the states of Goiás, Mato Grosso do Sul and Paraná (2 species each). In each of the other states (Mato Grosso, Pará, Rondônia, Rio Grande do Norte, Santa Catarina and São Paulo) there is only one endangered species. The southern region exhibits the highest number of endangered Asteraceae species (6 species), followed by the southeastern and midwestern (5), northern (2) and northeastern (1) regions. Minas Gerais and Rio Grande do Sul are the states with the highest number of endangered species.

As reported in the Red List (Fundação Biodiversitas 2007b), which shows the threat to

Table 8 – Distribution in Brazilian phytogeographical domains of threatened Asteraceae species indicated in the current Official List of Endangered Species of Brazilian Flora (MMA 2008).

Domain	Spp.	%
Amazon	1	6.6
Pampas	4	26.6
Cerrado	5	33.3
Atlantic Forest	4	26.6
Pantanal	1	6.6

Asteraceae, the southeastern region has the highest number of endangered species of the country. However, the northeastern, southern and midwestern regions are also very significant. Areas suitable for agriculture in the southern and southeastern regions and in the “Zona da Mata Nordestina” have been deforested in the last centuries (Primack & Rodrigues 2001), what can explain their high number of endangered species.

The state of Minas Gerais has the highest number of endangered species, mainly due to the high rate of endemism (Fundação Biodiversitas, 2007b) and to intensive anthropogenic influence, which transforms the native vegetation into forest fragments, with a landscape that has been extremely altered by agriculture, cattle raising, mining, and urbanization (Drummond 2009).

In the state of Bahia, the high rate of endemism, mainly in “Chapada Diamantina” (Teles & Bautista 2006; Teles *et al.* 2009), in addition to the high degree of anthropogenic disturbance can explain the high number of endangered species found in this state (MMA 2008).

The family Asteraceae is one of the most frequent in grasslands of southern Brazil (Ferreira *et al.* 2001; Caporal & Boldrini 2007), mainly in Rio Grande do Sul (Caporal & Boldrini 2007). Several species of this family are weedy or invasive in pastures (Ferreira *et al.* 2001). In addition to having a characteristic and exclusive flora, the natural landscape of southern grasslands has been under strong anthropogenic pressure throughout the past three centuries due to the expansion of agriculture, silviculture, and cattle raising (Overbeck *et al.* 2007), what explains the high number of endangered species in this region. However, most of the vegetation in southern Brazil remains poorly known (Giulietti *et al.* 2005), so it is important to

increase studies, in order to allow a better assessment of the conservation status of Asteraceae species.

Finally, in the state of Goiás, the number of endemic species is high mainly in "campos rupestres" (Bringel & Cavalcanti 2007; Alves & Kolbek 2010), what can explain its high number of endangered species.

Red List and criteria of IUCN 3.1

Considering that the Red List (Fundação Biodiversitas 2007b) were not considered by MMA as reliable, it is important to analyze the reasons for classifying the species as endangered (Appendix 2), according to IUCN's criteria (2001).

In the Red List (Fundação Biodiversitas 2007b), 97% of the species classified as critically endangered were placed in this category because they have restricted distribution, with an estimated occurrence range smaller than 100 km² or an estimated area of occupancy smaller than 10 km², and evidence of decline or fluctuation in their populations (IUCN 2001).

Most species assessed as endangered (85%) were placed in this category also because they have restricted distribution, with an estimated occurrence range smaller than 5,000 km² or an estimated area of occupancy smaller than 500 km², and evidence of decline or fluctuation in their populations (IUCN 2001).

Most species assessed as vulnerable (93%) had also restricted distribution, similarly as the critically endangered and endangered species; their estimated occurrence range is smaller than 20,000 km² or they exhibit an estimated area of occupancy smaller than 2,000 km², and evidence of decline or fluctuation in their populations due to anthropic activities, such as the extractivism (IUCN 2001).

Hence, most species were placed in threat categories of the Red List (Fundação Biodiversitas 2007b), mainly because of their restricted distribution and decline or fluctuation in their populations. Species with restricted distribution are vulnerable to extinction, especially if their habitat is disturbed by human activities. Likewise, populations in decline are vulnerable to extinction, especially if the causes of their decline are not identified and corrected (Primack & Rodrigues 2001). Hence, these species' vulnerability to extinction can be related to the habitat degradation that has been occurring for centuries in Brazil, resulting from the expansion of agriculture and cattle raising, urbanization, and poorly planned infra-structure works.

Therefore, the main threat to endangered species in Brazil, mainly for highly endemic species, is the degradation of their natural environments, be it through partial loss, total loss or change in optimal conditions, (Drummond *et al.* 2009; Fundação Biodiversitas 2007b; Primack & Rodrigues 2001).

According to Fundação Biodiversitas (2007b), the main recommendation is habitat protection, followed by research in biology and ecology, monitoring, research in taxonomy, recovery of habitats, and surveillance. To successfully preserve species, human activities that affect population stability and lead species to extinction must be identified. It is also necessary to determine which factors make a population vulnerable to extinction (Primack & Rodrigues 2001). By identifying these factors, it is possible to detect the need for management of populations of species vulnerable to extinction (Primack & Rodrigues 2001).

Threatened genera

In the First Official List (IBAMA 1992), the category rare included the genera *Aspilia* Thouars and *Lomatozona* Baker, and over half of the species (67%) belong to *Aspilia* Thouars (Tab. 9, category R). In the category vulnerable, the genus *Lychnophora* Mart. had only a single species (Tab. 9, category V).

The genus *Aspilia* Thouars is the most threatened in the First Official List (IBAMA 1992), since it exhibits most species assessed as R, the category with the highest extinction risk in this list. Species of *Aspilia* Thouars that are in this category are endemic, with restricted and local distribution (Santos 1996); possibly, these criteria were used to classify these species as R.

The other genera classified as endangered in the First Official List, *Lomatozona* Baker and *Lychnophora* Mart., included only a single species each, *Lomatozona artemisiifolia* Baker included as

Table 9 – Distribution of genera in the threatened categories (R e V) of the first Official List of Endangered Species of Brazilian Flora (IBAMA 1992), with the number of species in each genera.

Category	Genera	Species
Rare (R)	<i>Lomatozona</i>	1
	<i>Aspilia</i>	2
Vulnerable (V)	<i>Lychnophora</i>	1

R, and *Lychnophora ericoides* Mart. as V. There are few records for *L. artemisiifolia* Baker, what can be the reason for its classification as a rare and endangered. However, *L. ericoides* Mart., even having broad distribution (Semir 1991), in under uncontrolled extractivism and consequently is vulnerable to local and possibly regional extinction (Melo *et al.* 2009).

In the Red List (Fundação Biodiversitas 2007b), the category critically endangered encompassed 32 genera; 27% of the species belong to the genera *Lychnophora* Mart. (6 spp.), *Richterao* Kuntze (7 spp.) and *Vernonia* Schreb. (6 spp.), which have the highest number of species included in the list (Tab. 10). In the category endangered there were 15 genera; 14% of the species belong to the genus *Vernonia* Schreb. (3 spp.), which has the highest number of species (Tab. 10). In the category vulnerable there were 38 genera; 16% of the species belong to the genera *Richterao* Kuntze (6 spp.) and *Vernonia* Schreb. (6 spp.), which have the highest number of species (Tab. 10).

The genus *Vernonia* Schreb. was the most threatened in the Red List (Fundação Biodiversitas 2007b); it has the highest number of species in all categories of threat (CR, EN and VU). The genus *Vernonia* Schreb. is one of the most significant in the Cerrado (Althoff 1998), and in general its species have restricted distribution or are broadly distributed in savannas (Rivera 2006). The restricted distribution and occurrence of this genus in the Cerrado, a domain under intensive anthropic pressure, were the criteria to classify it as the most threatened.

Although the genus *Lychnophora* Mart. and *Richterao* Kuntze did not stand out broadly in this list, they were significant in some categories. *Lychnophora* Mart. was significant in the category CR, which has the highest extinction risk, and *Richterao* Kuntze was significant in the categories CR and VU, those with the highest and lowest extinction risk, respectively. The genera *Lychnophora* Mart. and *Richterao* Kuntze have several species that are locally endemic, and that occur in rocky fields in the states of Minas Gerais, Bahia and Goiás, areas under strong anthropic pressure (Semir 1991; Roque 1999). These factors can explain the significance of these genera in these two categories of threat.

Since the Red List is the one that best portrays the threat to Asteraceae, the genera *Lychnophora* Mart., *Richterao* Kuntze and *Vernonia* Schreb. are the most threatened in Brazil, with the highest number of species classified as endangered. Hence,

research aimed at the conservation of species of these genera should be encouraged.

In the Current Official List (MMA 2008), the category CR encompassed five genera; 62% of the species belong to the genera *Senecio* L. (3 spp.) and *Viguiera* Kunth (2 spp.) (Tab. 11). In the category EN there was only one genus, *Viguiera* Kunth, with a single species (Tab. 11). In the category VU, four genera were reported; more than half of the species (66%) belong to the genera *Aspilia* Thouars (2 spp.) and *Viguiera* Kunth (2 spp.) (Tab. 11). In the category DD, only one genus is reported, *Aspilia* Thouars, with a single species (Tab. 11).

The genus *Viguiera* Kunth is the most threatened in the list; it stood out due to the high number of species recorded in all categories of threat (CR, EN, and VU). Although the genera *Senecio* L. and *Aspilia* Thouars were not present in all categories of threat in this list, they were also significant: *Senecio* L. in the category CR, which has the highest risk of extinction; and *Aspilia* Thouars in the category VU, which has the lowest risk of extinction.

These three genera have species with restricted distribution or with broad distribution in different Brazilian biomes, in particular Cerrado (*Viguiera* Kunth and *Aspilia* Thouars) and Atlantic Forest (*Senecio* L.). *Viguiera* Kunth was recently the focus of a recent taxonomic review (Magenta 2006), as well as *Aspilia* Thouars (Santos 1996), what has been probably considered to classify them as endangered. *Senecio* L. is possibly among the most significant, because many of its species occur in the Atlantic Forest, one of the world's biodiversity hotspots.

Data deficient genera

In the First Official List (IBAMA 1992), a single genus was cited in the category undetermined (U): *Aspilia* Thouars with two species (50% of all species).

In the Red List (Fundação Biodiversitas 2007b), 55 genera were included in the category data deficient (DD). Data deficient species are placed in this category, because there is not enough information available to assess their conservation status. Hence, species placed in this category need further research (Fundação Biodiversitas 2007b).

The genera *Aspilia* Thouars (22 species or 10% of the DD species), *Baccharis* L. (13 species or 6%), *Calea* L. (12 species or 5%), *Eupatorium* L. (15 species or 7%), *Mikania* Willd. (12 species or 5%), *Piptocarpha* R.Br. (11 species or 5%), and

Table 10 – Distribution of genera in the threatened categories (CR, EN, e VU) of revised Red List of Brazilian Flora (Fundação Biodiversitas 2007b), with the number of species (n) and percentage (%) in each genera.

Critically endangered (CR)			Endangered (EN)			Vulnerable (VU)		
Genera	n	%	Genera	n	%	Genera	n	%
<i>Richtera</i>	7	10	<i>Vernonia</i>	3	14	<i>Richtera</i>	6	8
<i>Lychnophora</i>	6	8.5	<i>Acratopappus</i>	2	9.5	<i>Vernonia</i>	6	8
<i>Vernonia</i>	6	8.5	<i>Stylotrichium</i>	2	9.5	<i>Calea</i>	4	5.5
<i>Dimerostemma</i>	5	7	<i>Symphypappus</i>	2	9.5	<i>Lychnophora</i>	4	5.5
<i>Senecio</i>	5	7	<i>Viguiera</i>	2	9.5	<i>Paralychnophora</i>	4	5.5
<i>Viguiera</i>	4	6	<i>Baccharis</i>	1	4.8	<i>Stenopadus</i>	4	5.5
<i>Baccharis</i>	3	4	<i>Mikania</i>	1	4.8	<i>Mikania</i>	3	4
<i>Agrianthus</i>	2	3	<i>Minasia</i>	1	4.8	<i>Noticastrum</i>	3	4
<i>Aspilia</i>	2	3	<i>Perezia</i>	1	4.8	<i>Stilpnopappus</i>	3	4
<i>Chaptalia</i>	2	3	<i>Planaltoa</i>	1	4.8	<i>Viguiera</i>	3	4
<i>Hysterionica</i>	2	3	<i>Porophyllum</i>	1	4.8	<i>Aspilia</i>	2	3
<i>Mikania</i>	2	3	<i>Senecio</i>	1	4.8	<i>Dimerostemma</i>	2	3
<i>Paralychnophora</i>	2	3	<i>Stevia</i>	1	4.8	<i>Eremanthus</i>	2	3
<i>Stevia</i>	2	3	<i>Stilpnopappus</i>	1	4.8	<i>Eupatorium</i>	2	3
<i>Stylotrichium</i>	2	3	<i>Trichocline</i>	1	4.8	<i>Pamphalea</i>	2	3
<i>Wunderlichia</i>	2	3				<i>Stevia</i>	2	3
<i>Acratopappus</i>	1	1.5				<i>Baccharis</i>	1	1.3
<i>Anteremanthus</i>	1	1.5				<i>Chaptalia</i>	1	1.3
<i>Catolesia</i>	1	1.5				<i>Chionolaena</i>	1	1.3
<i>Dendrophorbium</i>	1	1.5				<i>Gardnerina</i>	1	1.3
<i>Eremanthus</i>	1	1.5				<i>Gochnatia</i>	1	1.3
<i>Ianthopappus</i>	1	1.5				<i>Heterocoma</i>	1	1.3
<i>Ichthyothere</i>	1	1.5				<i>Hoehnephytum</i>	1	1.3
<i>Lychnophoriopsis</i>	1	1.5				<i>Holocheilus</i>	1	1.3
<i>Monogereion</i>	1	1.5				<i>Ichthyothere</i>	1	1.3
<i>Ophyosporus</i>	1	1.5				<i>Isostigma</i>	1	1.3
<i>Perezia</i>	1	1.5				<i>Minasia</i>	1	1.3
<i>Smallanthus</i>	1	1.5				<i>Neblinae</i>	1	1.3
<i>Stenophalium</i>	1	1.5				<i>Proteopsis</i>	1	1.3
<i>Stilpnopappus</i>	1	1.5				<i>Quelchia</i>	1	1.3
<i>Symphypappus</i>	1	1.5				<i>Schlechtendalia</i>	1	1.3
<i>Verbesina</i>	1	1.5				<i>Senecio</i>	1	1.3
						<i>Smallanthus</i>	1	1.3
						<i>Stiffia</i>	1	1.3
						<i>Trichocline</i>	1	1.3
						<i>Trixis</i>	1	1.3
						<i>Wedelia</i>	1	1.3
						<i>Wunderlichia</i>	1	1.3

Table 11 – Distribution of genera in the threatened categories (CR, EN, VU e DD) of current Official List of Endangered Species of Brazilian Flora (MMA 2008), with the number of species (n) and percentage (%) in each genera.

Critically endangered (CR)			Endangered (EN)			Vulnerable (VU)			Data deficient (DD)		
Genera	n	%	Genera	n	%	Genera	n	%	Genera	n	%
<i>Senecio</i>	3	37.5	<i>Viguiera</i>	1	100	<i>Aspilia</i>	2	33.33	<i>Aspilia</i>	1	100
<i>Viguiera</i>	2	25				<i>Viguiera</i>	2	33.33			
<i>Anteremanthus</i>	1	12.5				<i>Chaptalia</i>	1	16.67			
<i>Hysterionica</i>	1	12.5				<i>Lychnophora</i>	1	16.67			
<i>Aspilia</i>	1	12.5									

Senecio L. (13 species or 6%) exhibited the highest number of data deficient species (Appendix 1).

Regarding the total number of species of each genus present in the list, 44% of the species of *Aspilia* Thouars were DD, 68% of *Baccharis* L., 75% of *Calea* L., 83% of *Eupatorium* L., 54% of *Mikania* Willd., 100% of *Piptocarpha* R.Br., and 56% of *Senecio* L.

All these genera have a high number of species and were not subjected to recent taxonomic review, except for *Aspilia* Thouars and *Senecio* L. Thus, for most species there is not enough knowledge on their distribution to apply IUCN's criteria (IUCN 2001), and so assess their conservation status.

In the Current Official List (MMA 2008), 55 genera are also included in the category data deficient. *Richtera* Kuntze (13 spp. or 9% of the DD species) and *Vernonia* Schreb. (15 spp. or 10%) had the highest number of data deficient species (Appendix 1).

All species of both genera included in this list were classified as data deficient. However, *Richtera* Kuntze was focused on a recent taxonomic review (Roque 1999), and *Vernonia* Schreb. is relatively well known through information from herbaria, corroborating the hypothesis that the Current Official List (MMA 2008) did not properly survey the scientific literature.

Red lists of the Brazilian flora have reported throughout 16 years (1992–2008) a variable number of both endangered and data deficient species of Asteraceae. This variation is a result of different criteria used to elaborate these lists. The Red List (Fundação Biodiversitas 2007b) is the only one that uses well-defined criteria in its methodology and, hence, it is the one that best portrays the real situation of endangered Asteraceae species in Brazil.

The Current Official List (MMA 2008) does not show the real situation of endangered Asteraceae, with a reduction of 90% in species that had been previously been classified as endangered in the Red List (Fundação Biodiversitas 2007b), but were classified as data deficient in the Current Official List (MMA 2008); there was also an arbitrary exclusion of 209 species included in the Red List, without using scientific criteria known.

All species included in the First Official List (IBAMA 1992) have been reported in the subsequent lists, and even after 16 years, those six Asteraceae species did not have their conservation status changed, what possibly portrays fragilities and deficiencies of the system for protection, management and control of endangered species in Brazil.

According to the analysis of the Red List, most Asteraceae species placed in any category of endangered were classified so mainly due to their restricted distribution, population decline, and deterioration of their natural habitats, which is the main threat to biodiversity in Brazil. Most species were placed in the categories critically endangered and vulnerable. The adoption of moderate conservation measures can reverse the threat to these vulnerable species. However, in order to reverse the threat to critically endangered species, more drastic measures are needed, since they are at high extinction risk in the near future.

In general, 20% of the Asteraceae species that occur in Brazil are reported in red lists as endangered or data deficient. The genera diagnosed as the most threatened in Brazil (*Lychnophora* Mart., *Richtera* Kuntze and *Vernonia* Schreb.) must be prioritized in studies that provide the basis for conservation and management projects of these endangered species and for identifying priority areas for their conservation.

Despite the significant number of endangered Asteraceae species, they represent less than half of the species reported in red lists. Most species are classified as data deficient, with insufficient information for assessing their real conservation status. Many gaps in knowledge still need to be filled so that science can help conservation actions. Hence, most data deficient genera in Brazil (*Aspilia* Thouars, *Baccharis* L., *Calea* L., *Eupatorium* L., *Mikania* Willd., *Piptocarpha* R.Br. and *Senecio* L.) should be prioritized in research programs aimed at understanding the distribution of these species, as they may be seriously threatened and under high risk of extinction.

Therefore, there has been an improvement in the reliability of Brazilian red lists, through the use of up-to-date, applicable and objective scientific criteria, which are consequently more reliable and viable. This development reflects the growing interest and concern about endangered species in Brazil, which can be observed in federal laws, as well as in the laws of several states.

With the analysis of threat to the Asteraceae, this study points out the importance of carrying out further floristic inventories in Brazil, in order to provide the basis for conservation of endangered and data deficient species. However, for inventories to be carried out and species to be correctly identified, it is necessary to form new generations of taxonomists, who should play a central role in the elaboration and assessment of the red lists of Brazilian flora.

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