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Potential For Using Native Species From Rocky Fields In An Ecological Landscape

Potencial De Espécies Nativas De Campo Rupestre Para Paisagismo Ecológico

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ABSTRACT

Objective: Focusing on native species of the rocky fields of Serra de Itacambira, Minas Gerais state, Brazil, we analyzed physiological and structural traits of leaves, flowers or of the plant as a whole toward selecting out species with potential use for ecological landscaping. **Methodology:** A total of 61 plant species belonging to 29 families were collected, analyzed, and the characteristics of their flowers, leaves, and stems were described. **Results:** These species were pointed out for uses in landscaping, as vertical gardens, roofing of buildings, borders, mass flower designs, and even isolated use in beds. Twenty three out of the 61 identified species were highlighted for supporting low water availability and having a high interaction with local fauna.**Conclusion:** Based on their structure and physiological traits, the 61 plant species collected in Serra da Itacambira have potential use in ecological landscaping, especially in drought-resistant gardens.

Keywords: Biodiversity; Cerrado, Drought resistance, Ornamental plants, Native plants

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RESUMO

Objetivo: Com foco nas espécies nativas dos campos rupestres da Serra de Itacambira, Minas Gerais, Brasil, o objetivo foi analisar características fisiológicas e estruturais de folhas, flores ou da planta como um todo, visando selecionar espécies com potencial uso para paisagismo ecológico. **Metodologia:** Foram coletadas e analisadas 61 espécies de plantas pertencentes a 29 famílias e descritas as características de suas flores, folhas e caules. **Resultados:** As espécies analisadas foram apontadas para uso em paisagismo, como jardins verticais, coberturas de edifícios, bordaduras, composição de maciços com flores e até uso isolado em canteiros. Vinte e três das 61 espécies identificadas foram destacadas por suportarem baixa disponibilidade hídrica e terem alta interação com a fauna local. **Conclusões:** Com base em sua estrutura e características fisiológicas, as 61 espécies de plantas coletadas na Serra da Itacambira têm potencial de utilização no paisagismo ecológico, especialmente em jardins resistentes à seca.

Palavras-chave: Biodiversidade, Cerrado, resistência à seca, plantas nativas, plantas ornamentais

INTRODUCTION

Landscaping can be used as an instrument to combine plant ornamental value with other benefits plants can provide to the environment toward improving urban environmental quality[1]. One of the principles of contemporary landscaping focuses on ecology and integration with the environment as a whole, which is performed by the use of tools for planning and building spaces beyond providing scenic landscapes. The creation of such spaces aims at criteria such as functionality and respect for the environment, with principles that value the environment and benefit all forms of life[2].

Recreating environments as refugia for fauna in urban environments, providing better absorption of rainwater, combating the effects of urban heat islands, and forming milder microclimates are also ecological services that can be offered through landscaping in addition to aesthetic services[3]. Thus, plant native species use in landscape projects can be adopted to integrate these services in gardens[1].

The use of plant native species has been increased in landscaping mainly due to the important ecological functions they play in the ecosystem and their adaptability to water requirements according to the climatic conditions of their region of origin[4]. Native plants are

more resistant to the attack of pests and diseases, they attract specific insects as pollinators, promoting ecosystem balance, and their use in gardens facilitates restoration and regional identity[5]. The cultivation of these species, especially those at risk of extinction, can be a means of conserving them outside their habitat so that they are protected, in cases in which their natural environments are threatened by constant anthropogenic activities[6,7]. A range of species with ornamental features can be found in Brazilian biomes, and their domestication may allow greater diversity in gardens.

The Cerrado is the second largest Brazilian biome, as it accounts for approximately 23% of the country's area, and it is the biologically richest tropical savanna in the world[8]. The soils in Cerrado areas are mainly characterized by high acidity levels and nutrient deficiencies. This biome has different phytophysiognomies, and, according to its vegetation architecture and composition, can be subdivided into savanna (*cerrado stricto sensu* and *cerrado ralo*), forest (semideciduous seasonal forest, gallery forest, and *cerradão*), grassland (*campo sujo, campo limpo*) and rocky fields[9].

The rocky fields are characterized by shrubby herbaceous vegetation that develops on quartzitic, sandy, clear, and nutrient-poor soils at altitudes above 900 m[10]. Accordingly, the rocky fields are considered a hotspot of biodiversity and constitute a unique and diverse environment, where most of the species are endemic[11]. The vegetation in rocky fields is distributed in "patches" according to the type of microhabitat that is formed on various substrates, such as wet fields, sandy fields, rocky fields, and rocky outcrops[11]. With such diversity, it is natural that many species have characteristics of interest for landscaping, but to date, they have not been used due to the scarcity of research on this perspective[12].

Among the important groups of plants occurring in rocky fields, species of the Orchidaceae and the group of "always-alive" flowers, have species collected to the commerce of their floral scapes and flower buds for use in handcrafts and dry floral bouquets[13]. These two specific categories were not inserted in this study because their use have been intensely studied in commercial ad ethnobotanical perspectives[14]. Currently, our objective is to identify and characterize the plant native species that occur in the rocky field located in the Serra da Itacambira in the northern region of the state of Minas Gerais, Brazil, that have ornamental traits suitable for use in ecological landscaping. The identified species compose a list of species from rocky fields with potential use in projects of landscaping.

MATERIAL AND METHODS

Study Area

The collection area is at the Serra da Itacambira, municipality of Itacambira, northern Minas Gerais state, Brazil (Figure 1), 15 km away from the municipality of Itacambira, with approximately 83 ha. The climate of the region is temperate and classified as Cwa of Köeppen[15]. It has an average temperature of approximately 19.9 °C, with drastic oscillations, intense heat during the day, and cold at night. It has an average annual rainfall of 1,092 mm and an altitude of 1,113 m[16] with predominance of herbs and shrubs typical of rocky fields.

Figure 1. Map of the study area (marked in red) in rocky fields, where native species with ornamental potential were collected. Itacambira, MG, Brazil, 2019. (Google Earth, 2019)

Field expeditions and species collection

Field expeditions to the Serra da Itacambira were conducted between September 2019 and April 2020 to collect native plant species. The predefined area (highlighted on the map) was covered by unsystematic walking, and all plants with flowers, fruits, leaves, and stems, or whose whole-plant morphological characteristics could be considered ornamental were collected[17]. Due to the environmental heterogeneity of the area, data related to flowering period,

and the type of substrate where the plants were found (wet, dry, sandy, rocky, and rocky outcrop) were annotated. Plant parts such as branches, leaves, and flowers were preserved in exsiccates, and the plants were photographed in their natural environment to help identifying the species and presenting them to the public through the publication of articles.

The collection periods included the Spring, Summer, and Autumn, and the rainy (December to April) and dry (September to November) seasons, to obtain the highest number of observations of the species and the environment.

Voucher species was deposited in the Herbário Norte Mineiro (MCCA) of the Institute of Agricultural Sciences of the Universidade Federal de Minas Gerais (ICA-UFMG), after the standard procedures of pressing, drying, and identification[18]. The Botanical identity confirmation at species level and information on their occurrence, endemism, and flowering were obtained by consulting Botanists, the database of the MCCA of the ICA – UFMG, and the Flora of Brazil 2020[19].

Determination of ornamental characteristics

The characteristics considered essential for identifying potentially ornamental species were adapted from literature[17,20]. Information on the aesthetic important variables for characterizing the species as ornamental was the colour, growth habit, texture, symmetry, and aroma[20] (Table 1). The species were also classified according to their potential for use in landscaping as plants of gardens (indicated for hedgerows, formation of massifs and linings, borders, vertical gardens, or isolated use), plants for pots (indicated for cultivation in containers of different volumes), and plants for cut flowers and leaves (indicated for cultivation so that their flowers and leaves can be cut for floral arrangements)[20].

The analysis of ornamental potential was also based on hardiness attributes (species that occur in areas with different light intensities, moisture levels, and substrates)[17].

RESULTS AND DISCUSSION

Floristic survey and ornamental morphological characteristics

A total of 61 plant species that belong to 29 botanical families, including Asteraceae with 9 genera (9 spp.), Melastomataceae with 8 genera (8 spp.), Fabaceae with 4 genera (5

spp.), Apocynaceae with 3 genera (4 spp.), Velloziaceae with 2 genera (4 spp.), and Eriocaulaceae with 3 genera (3 spp.) were identified and characterized (Table 1). All species had leaf, flower, and stem characteristics indicative of ornamental use. Most species flowered between September and February, coinciding with data on literature about the rocky field species. The large number of species identified in this study reinforces the premisse that the richness of plants with ornamental potential follows the richness of families in rocky field areas[21] .

The 61 species include shrubs, herbs, and vine plants have ornamental characteristics, and have grown in diverse types of substrate (Table 1). Regarding the growth habit, 38 are shrub species (62%), 21 are herbaceous species (35%), and two are vine species (3%). Regarding hardiness, 22 species, especially *Philodendron uliginosum, P. undulatum*, and *Mandevilla tenuifolia*, had hardiness characteristics related to their natural adaptation in environments with different light intensities, moisture levels, and substrates.

Table 1. Shrub, herbaceous, and vine species collected in the rocky field of Serra da Itacambira with description of the characteristics evaluated for identifying plants for ornamental use.

Habits/ Species	**Substrate**	**Orn. Str**	**Str. Col**	**Leaf Tex.**	**Sym**	**Ar**	**Rust**	**Potential of use**
Shrub								
***Augusta longifolia* (Spreng.) Rehder**	Rock. Outcr.	Flower	Red	Sm/Gl	S	A		Garden/Pots
***Allamanda puberula* A.DC**	Sandy	Flower	Yellow	Sm/Gl	As	P/Ple	x	Garden/Pots
***Andira humilis* Mart. ex Benth.**	Sandy	Inflo	Purple	Sm/Gl	As	A		Garden
***Aspilia foliosa* (Gardner) Baker**	Sandy	Flower	Yellow	Sm/Gl	S	A	x	Garden/Pots
***Baccharis platypoda* DC.**	Sandy	Inflo	Lig. Gre	Sm/Gl	As	A		Cut
***Baccharis tridentata* Baker**	Sandy	Leaf	Green	Sm/Gl	S	AP/PIe		Cut

***Byrsonima sericea* DC.**	Sandy	Inflo	Yellow	Sm/Gl	As	AP/Ple		Garden
***Calliandra dysantha* Benth.**	Sandy	Inflo	Red	Sm/Gl	As	A	x	Garden/Pots
***Calliandra asplenioides* (Nees) Renvoize**	Rock. Outcr.	Flower	Whi/ Pink	Sm/Gl	As	A	x	Garden/Pots
***Cambessedesia hilariana* (Kunth) DC**	Rock. Outcr.	Flower	Red/ Yellow	Sm/Gl	As	A	x	Garden/Pots
***Cipocereus minensis* (Werderm.) Ritter**	Rock. Outcr.	Fruit	Blue	Sm/Gl	S	A		Garden/Pots
***Chamaecrista ramosa* (Vogel) H.S.Irwin & Barneby**	Sandy	Flower	Yellow	Sm/Gl	S	A		Garden
***Clusia obdeltifolia* Bittrich**	Rock. Outcr.	Wh. Plant	Green	Sm/Gl	S	A		Garden
***Diplusodon hirsutus* (Cham. & Schltdl.) A.DC**	Sandy	Flower	Pink	Sm/Gl	As	A		Garden/Pots
***Disynaphia praeficta* (B.L.Rob.) R.M.King & H.Rob.**	Sandy	Inflo	Pink	Sm/Gl	S	P/Ple		Garden/Pots
***Kielmeyera regalis* Saddi**	Rock.Out/San	Flower	Pink	Sm/Gl	As	P/Ple	x	Garden
***Lavoisiera mellobarretoi* Markgr.**	Rock. Outcr.	Flower	Pink	Sm/Ha	As	A		Garden/Pots

***Lavoisiera imbricata* (Thunb.) DC.**	Sandy	Flower	Pink	Sm/Ha	As	A		Garden/Pots
***Luxemburgia mogolensis* Feres**	Rock. Outcr.	Leaf/ Inflo	Red/ Yel	Sm/Ha	As	A	x	Garden/Pots
***Lippia hederifolia* Mart. & Schauer**	Sandy	Flower	Pink	Ro/Gl	As	A	x	Garden/Pots
***Marcetia taxifolia* (A.St.-Hil.) DC.**	Stony/ Sandy	Inflo	White	Sm/Ha	As	A		Garden/Pots
***Microlicia tetrasticha* Cogn.**	Rock. Outcr.	Flower	Pink	Sm/Gl	S	A		Garden/Pots
***Moquinia racemosa* (Spreng.) DC**	Sandy	Inflo	Pink	Sm/Gl	As	P/Ple		Garden/Pots
***Mimosa regina* Barneby**	Sandy	Flower	Pink	Sm/Ha	As	A		Garden
***Pavonia viscosa* A.St.-Hil**	Rock. Outcr.	Flower	Red/ Oran	Sm/Ha	As	A		Garden
***Pilosocereus fulvilanatus* (Buining & Brederoo) Ritter**	Rock. Outcr.	Fruit/Stem	Pink	Sm/Gl	S	A		Garden/Pots
***Phyllanthus klotzschianus* Müll.Arg.**	Rock.Out/San	Leaf	Ligh. Gre	Sm/Gl	As	A		Garden/Pots
***Pseudobrickellia angustissima* (Spreng. ex Baker) R.M.King & H.Rob.**	Sandy	Inflo	Yellow	Sm/Gl	S	A		Garden/Pots

***Sauvagesia elegantissima* A.St.-Hil**	Rock.Out/San	Stem/Inflo	Gre/Whit	Sm/Gl	As	A	x	Garden/Pots
***Schefflera gardneri* (Seem.) Frodin & Fiaschi**	Sandy	Leaf	Green	Sm/Gl	S	A		Garden/Pots
***Stachytarpheta glabra* Cham**	Sandy	Flower	Blue	Sm/Gl	S	A	x	Garden/Pots
***Stenandrium hatschbachii* Wassh.**	Sandy	Flower	Purple	Sm/Gl	As	A		Garden/Pots
***Schwartzia adamantium* (Cambess.) Bedell ex Gir.-Cañas**	Sandy	Inflo/Leaf	Gre/Red	Sm/Gl	As	A	x	Garden
***Tibouchina candolleana* (Mart. ex DC.) Cogn.**	Sandy	Flow/ Leaf	Pur/ Green	Ro/Ha	As	A		Garden
***Tibouchina heteromalla* (D.Don) Cogn**	Rock. Outcr.	Inflo	Purple	Ro/Ha	S	A		Garden
***Tococa guianensis* Aubl.**	Rock. Outcr.	Inflo/Infr	Dark Green	Ro/Ha	As	A		Garden
***Vellozia maxillarioides* L.B.Sm**	Sandy	Wh.Pl/Flow	Purple	Sm/Ha	S	A		Garden/Pots
***Wunderlichia mirabilis* Riedel ex Baker Herbaceous**	Rock. Outcr.	Wh. Plant	Silver	Ro/Ha	As	A	x	Garden/Pots

***Actinocephalus bongardii* (A.St.-Hil.) Sano**	Sandy	Inflo	White	Sm/Ha	S	A		Pots/Cut
***Alstroemeria cunha* Vell.**	Sandy	Flower	Red/ Yel	Sm/Gl	S	A		Cut/Pots
***Barbacenia umbrosa* L.B.Sm. & Ayensu**	Rock. Outcr.	Flower	Red	Sm/Gl	As	A		Garden/Pots
***Begonia grisea* A.DC**	Rock.Out/San	Inflo	Pink	Sm/Ha	As	A	x	Garden/Pots
***Drosera graomogolensis* T.Silva**	Rock. Outcr.	Wh.Pl/ Leaf	Red	Sm/Ha	S	A		Pots
***Encholirium biflorum*(Mez) Forzza**	Sandy	Wh. Plant	Green	Sm/Gl	S	A		Garden/Pots
***Euphorbia sarcodes* Boiss.**	Sandy	Flow/Leaf	Yell/ Green	Sm/Gl	As	A	x	Garden/Pots
***Evolvulus glomeratus* Nees & Mart.**	Sandy	Flower	Blue	Sm/Ha	As	A	x	Garden/Pots
***Hippeastrum morelianum* Lem.**	Sandy	Flower	Red	Sm/Gl	S	A		Cut/Garden
Lychnophora itacambirensis	Rock. Outcr.	Flower	Purple	Sm/Gl	As	A		Garden/Pots
***Mandevilla tenuifolia* (J.C.Mikan) Woodson**	Rock. Outcr.	Flower	Purple	Sm/Gl	As	A	x	Garden/Pots
***Paepalanthus eriophaeus* Ruhland**	Sandy	Inflo/ Leaf	Whi/ Green	Sm/Ha	S	A		Garden/Pots/ Cut

***Piriqueta duarteana* (Cambess.) Urb.**	Sandy	Flower	Purple	Ro/Ha	As	A		Garden/Pots
***Portulaca mucronata* Link.**	Sandy	Flower	Yellow	Sm/Gl	As	A		Garden/Pots
***Portulaca hirsutissima* Cambess.**	Rock. Outcr.	Flower	Yellow	Sm/Ha	As	A		Garden/Pots
***Thaumatophyllum uliginosum* Mayo.**	Wet/ Sandy	Leaf	Ligh. Green	Sm/Gl	S	A	x	Garden/Pots/ Cut
***Thaumatophyllum undulatum* Engl.**	Wet/ Sandy	Leaf	Dark Gree	Sm/Gl	S	A	x	Garden/Pots/ Cut
***Proteopsis argentea* Mart. & Zucc. ex Sch.Bip.**	Sandy	Flower	Purple	Sm/Ha	S	A	x	Garden
***Syngonanthus verticillatus* (Bong.) Ruhland.**	Sandy	Flor/ Wh.Pl	Whi/ Green	Sm/Ha	S	A		Garden/Pots/ Cut
***Vellozia aloifolia* Mart.**	Clayish/ San	Flower	Pink	Sm/Gl	S	A	x	Garden
***Vellozia subscabra* J.C.Mikan.**	Sandy	Flower	Pink	Sm/Gl	S	A		Garden
Vine				Sm/Gl				
***Mandevilla semirii* M.F.Sales et al**	Rock.Out/San	Flower	Pink	Sm/Gl	As	A	x	Garden/Pots
***Stipecoma peltigera* (Stadelm.) Müll.Arg**	Stony/ Sandy	Flower	Pink	Sm/Gl	As	A	x	Garden/Pots

Legend: ROCK. OUTCR = rocky outcrop; SAN = sandy; ORN. STR = ornamental structure; INFLO. = inflorescence; WH. PL = whole plant; COR STR. = structure colour: GRE = green; LIGH. GRE = light green; DARK GREE. = dark green; YEL= yellow; WHI = white; LEAF TEX = leaf texture: RO = rough; SM. = smooth; HA. = hair; GL. = glabrous; SYM. =symmetry: S. = symmetric; AS. = asymmetric; AR. = aroma: P. = present; A. = absent; PLE = pleasant; and RUST. = rusticity.

Among the 61 species analyzed, 51 are endemic (Tables 2 and 3); that is, they do not occur in other environments, and 22 species were only recorded in Minas Gerais.

The large number of different sized plants (trees, shrubs, and herbs) is of great relevance in landscaping because a variation in height promotes different shapes and volumes, resulting in gardens better resembling natural spaces. The promotion of the diversity of plants with variable sizes breaks the monotony of gardens and can provide a better experience of using these spaces[22].

Table 2. General characteristics of the shrub species collected at Serra da Itacambira, Minas Gerais (MG).

Family	Habits/Species	Ornam. Struc.	Endemism	Occurs only in MG
Shrub				
Rubiaceae	*Augusta longifolia* (Spreng.) Rehder	Flower	Yes, Brazil	
Apocynaceae	*Allamanda puberula* A.DC.	Flower	Yes	
Fabaceae	*Andira humilis* Mart. ex Benth.	Inflo	Yes, Brazil	
Asteraceae	*Aspilia foliosa* (Gardner) Baker	Flower	Yes, Brazil	
Asteraceae	*Baccharis platypoda* DC.	Inflo	No	

Asteraceae	*Baccharis tridentata* Baker	Leaf	No	
Malpighiaceae	*Byrsonima sericea* DC.	Inflo	No	
Fabaceae	*Calliandra dysantha* Benth.	Inflo	No	
Fabaceae	*Calliandra asplenioides* (Nees) Renvoize	Flower	Yes, Brazil	
Melastomataceae	*Cambessedesia hilariana* (Kunth) DC	Flower	Yes, Brazil	
Cactaceae	*Cipocereus minensis* (Werderm.) Ritter	Fruit	Yes, Brazil (VU)	X
Fabaceae	*Chamaecrista ramosa* (Vogel) H.S.Irwin & Barneby	Flower	Yes	
Clusiaceae	*Clusia obdeltifolia* Bittrich	Wh. Plant	Yes, Brazil	
Lytraceae	*Diplusodon hirsutus* (Cham. & Schltdl.) A.DC	Flower	Yes, Brazil	X
Asteraceae	*Disynaphia praeficta* (B.L.Rob.) R.M.King & H.Rob.	Inflo	Yes, Brazil (EN)	X
Callophylaceae	*Kielmeyera regalis* Saddi	Flower	Yes, Brazil	X
Melastomataceae	*Lavoisiera mellobarretoi* Markgr.	Flower	Yes, Brazil	X
Melastomataceae	*Lavoisiera imbricata* (Thunb.) DC.	Flower	Yes, Brazil	
Ochnaceae	*Luxemburgia mogolensis* Feres	Leaf/Inflo	Yes, Brazil	X

Verbenaceae	*Lippia hederifolia* Mart. & Schauer	Flower	Yes		
Melastomataceae	*Marcetia taxifolia* (A.St.-Hil.) DC.	Inflo	Yes, Brazil		
Melastomataceae	*Microlicia tetrasticha* Cogn.	Flower	Yes, Brazil	X	
Asteraceae	*Moquinia racemosa* (Spreng.) DC	Inflo	Yes, Brazil		
Fabaceae	*Mimosa regina* Barneby	Flower	Yes, Brazil (EN)		
Malvaceae	*Pavonia viscosa* A.St.-Hil	Flower	Yes, Brazil	X	
Cactaceae	*Pilosocereus fulvilanatus* (Buining & Brederoo) Ritter	Fruit/Stem	Yes, Brazil (EN)	X	
Phyllanthaceae	*Phyllanthus klotzschianus* Müll.Arg.	Leaf	Yes, Brazil		
Ochnaceae	*Sauvagesia elegantissima* A.St.-Hil.	Inflo	Yes, Brazil		X
Asteraceae	*Pseudobrickellia angustissima* (Spreng. ex Baker) R.M.King & H.Rob.	Stem/Inflo	Yes, Brazil		
Araliaceae	*Schefflera gardneri* (Seem.) Frodin & Fiaschi	Leaf	Yes, Brazil		X
Verbenaceae	*Stachytarpheta glabra* Cham	Flower	Yes, Brazil		
Acanthaceae	*Stenandrium hatschbachii* Wassh.	Flower	Yes, Brazil (EN)		X
Marcgraviaceae	*Schwartzia adamantium*	Inflo/Leaf	Yes, Brazil		

	(Cambess.) Bedell ex Gir.-Cañas		
Melastomataceae	*Tibouchina candolleana* (Mart. ex DC.) Cogn.	Flow/Leaf	Yes
Melastomataceae	*Tibouchina heteromalla* (D.Don) Cogn	Inflo	Yes, Brazil
Melastomataceae	*Tococa guianensis* Aubl.	Inflo/Infr	No

Legend: ORNAM. STRUC = ornamental structure; INFLO. = inflorescence; WH. PL. = whole plant; EN = Endangered; VU = Vulnerable.

Table 3. General characteristics of the herbaceous and vine plants collected at the Serra da Itacambira, Minas Gerais (MG).

Family	Habits/Species	Ornam. Struc.	Endemism	Occurs only in MG
Herbaceous				
Eriocaulaceae	*Actinocephalus bongardii* (A.St.-Hil.) Sano	Inflo	Yes, Brazil	
Alstroemeriaceae	*Alstroemeria cunha* Vell.	Flower	Yes, Brazil	
Velloziaceae	*Barbacenia umbrosa* L.B.Sm. & Ayensu	Flower	Yes, Brazil (EN)	X
Begoniaceae	*Begonia grisea* A.DC	Inflo	Yes, Brazil	
Droseraceae	*Drosera graomogolensis* T.Silva	Wh.Pl/Leaf	Yes, Brazil (EN)	X
Bromeliaceae	*Encholirium biflorum* (Mez) Forzza	Wh. Plant	Yes	X
Euphorbiaceae	*Euphorbia sarcodes* Boiss.	Flow/Leaf	Yes, Brazil	
Convolvulaceae	*Evolvulus glomeratus* Nees & Mart.	Flower	No	

Amaryllidaceae	*Hippeastrum morelianum* Lem.	Flower	Yes, Brazil (VU)	
Asteraceae	*Lychnophora itacambirensis* Semir & Leitão Filho	Flower	Yes, MG	X
Apocynaceae	*Mandevilla tenuifolia* (J.C.Mikan) Woodson	Flower	No	
Euriocaulaceae	*Paepalanthus eriophaeus* Ruhland	Inflo/Leaf	Yes, Brazil	X
Turneraceae	*Piriqueta duarteana* (Cambess.) Urb.	Flower	Yes, Brazil	
Portulacaceae	*Portulaca mucronata* Link.	Flower	No	
Portulacaceae	*Portulaca hirsutissima* Cambess.	Flower	Yes, Brazil	X
Araceae	*Thaumatophyllum uliginosum* Mayo.	Leaf	Yes	
Araceae	*Thaumatophyllum undulatum* Engl.	Leaf	No	
Asteraceae	*Proteopsis argentea* Mart. & Zucc. ex Sch.Bip.	Flower	Yes, Brazil (VU)	
Euriocaulaceae	*Syngonanthus verticillatus* (Bong.) Ruhland.	Flor/Wh.Pl	Yes, Brazil	X
Velloziaceae	*Vellozia aloifolia* Mart.	Flower	Yes, Brazil	X
Velloziaceae Vine	*Vellozia subscabra* J.C.Mikan.	Flower	Yes, Brazil	X
Apocynaceae	*Mandevilla semirii* M.F.Sales et al	Flower	Yes, Brazil (EN)	X
Apocynaceae	*Stipecoma peltigera* (Stadelm.) Müll.Arg	Flower	No	

Legend: ORNAM. STRUC = ornamental structure; INFLO. = inflorescence; WH. PL = whole plant; EN = Endangered; VU = Vulnerable; CR = Critically Endangered.

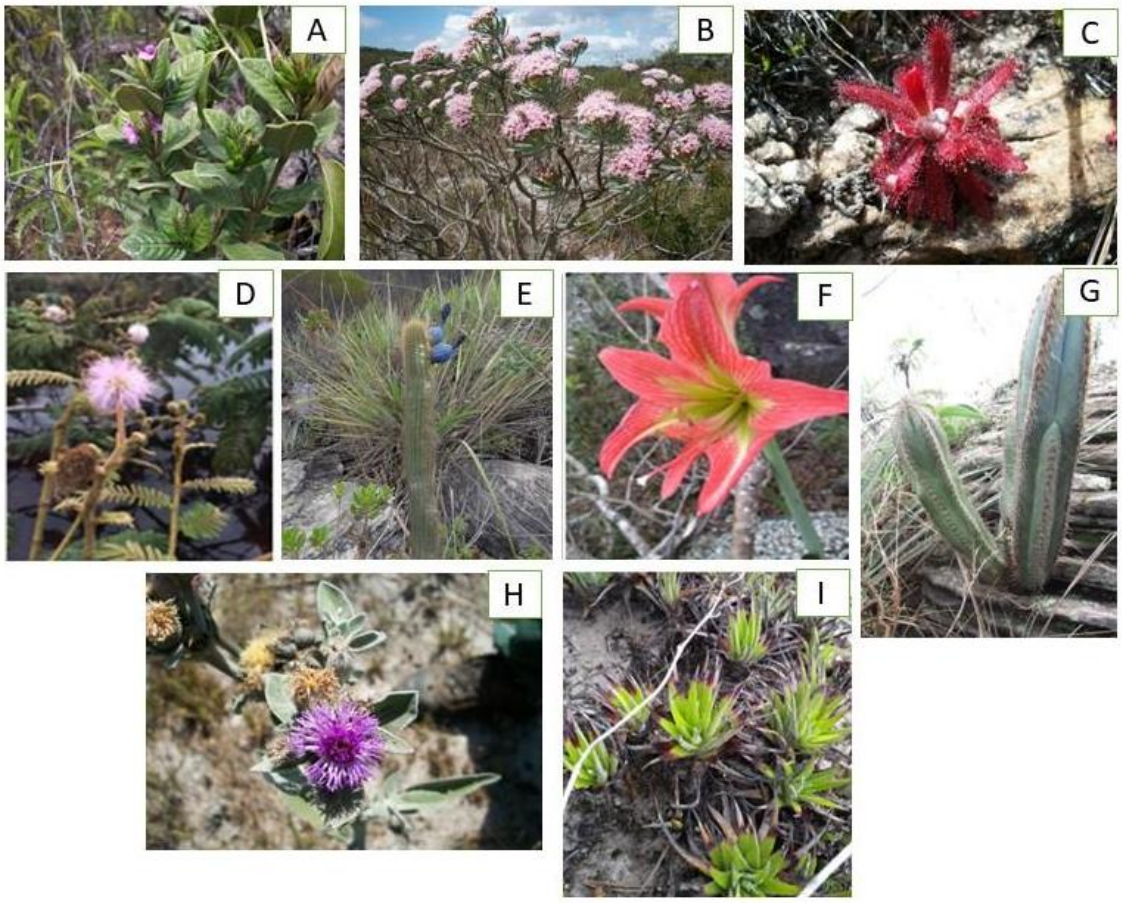

Figure 2. Species classified as Endangered: A. *Stenandrium hatschbachii,* B. *Disynaphia praeficta,* C. *Drosera graomogolensis,* D. *Mimosa regina;* Species classified as Vulnerable*:* E. *Cipocereus minensis* F. *Hippeastrum morelianum,* G. *Pilosocereus fulvilanatus* H. *Proteopsis argentea,* and species classified as critically endangered: I. *Encholirium biflorum.*

Among the species identified, *Stenandrium hatschbachii, Disynaphia praeficta, Drosera graomogolensis, Mimosa regina*, and *Pilosocereus fulvilanatus* are considered endangered (EN) species, *Cipocereus minensis*, *Proteopsis argentea,* and *Hippeastrum morelianum* are considered vulnerable (VU) and *Encholirium biflorum* is considered a critically endangered (CR) species by the Official list of threatened species of Brazilian flora[23] (Table 2, 3) (Figure 2).

The use of native plants in gardens can prevent their extinction, as popularized by Burle Marx, who used many previously unknown species in his projects[24]. Many projects may face the challenge of preserving the environment, establishing ecophysiological relationships in

gardens, and enhancing the regional landscape. Species of Bromeliaceae from the Atlantic Forest, for example, became popular due to their frequent insertion in gardens designed by Burle Marx, the great landscaper of Brazil[22]. In addition to using them in his projects, Burle Marx also collected many species of the rock fields biome and, as a result, contributed to an increase in the collection of native plants with ornamental potential, and possibly, because of his efforts, several of these species are conserved.

Considering that the 61 plants identified in the rocky fields of the Serra of Itacambira have ornamental potential, their dissemination contributes to the better recognition of their potential for landscaping projects. Thus, the introduction of these plants in commercial cultivation systems can be an effective tool for their conservation. In addition, their propagation in regulated nurseries reduces the risk of their illegal collection in nature[22].

Categories of species use

All the 61 species are heliophytes collected in open rocky fields under intense insolation; and therefore can be indicated for use in open areas with full sunlight. Most of the collected plants have a shrub growth habit (39 species) with the potential for cultivation in pots or gardens. Some larger species, such as *Tibouchina heteromalla, T. candolleana, Clusia obdeltifolia, Moquinia racemosa, Pavonia viscosa, Andira humilis, Banisteriopsis* sp. and *Allamanda puberula* (Figure 3), can be used in public squares and open places individually or in groups, as they can reach 1.7 to 4 meters in height[25], and have long-lasting and showy foliage and flowers, as observed in the field. *Allamanda puberula* can be used as a cover on pergolas, planted near walls or in pots, as its shape allows use in irregular soils, and when in small clusters, it provides amplitude to a garden, and *A. cathartica* is a commonly used species, already widespread in landscaping[20].

Figure 3. Shrub species with potential for cultivation in public squares: 1. *Tibouchina heteromalla,* 2. *Clusia obdeltifolia,* 3. *Andira humilis,* 4. *Banisteriopsis* sp., 5. *Moquinia racemosa, 6. T. candolleana,* 7. *Allamanda cathartica, and* 8. *Pavonia viscosa.*

In addition to aesthetic values, species such as *M. racemosa, T. heteromalla, T. candolleana, A. humilis,* and *P. viscosa* provide shade for much of the year and attract pollinators through the pleasant scent of their inflorescences.

Figure 4. Shrub species with potential for potting and bonsai production: 1. *Calliandra dysantha* and 2. *Calliandra asplenioides.*

Calliandra dysantha, *C. asplenioides*, and *M. regina* (Figure 4) have an average size up to 3 m high, with many branches and floral structures that stand out for their colours and textures, providing natural garden characteristics. Species of the genus *Calliandra* and *Mimosa* are highlighted by their potential as bonsai due to the volume and shape of the canopy, which

accept artistic pruning[26]. These species also have the potential to be cultivated in gardens as isolated plants or mass flowers.

The shrub species that stand out for their potential use as mass flowers, in pots in full sun, and individually or forming borders in gardens are *Disynaphia praeficta*, *Kielmeyera regalis*, *Diplusodon hirsutus*, *Luxemburgia mogolensis*, *Pseudobrickellia angustissima*, and *Microlicia tetrasticha* (Figure 5). These plants have valuable ornamental traits, such as large or abundant flowers, scent, attractiveness to fauna, and leaves with different characteristics, that together with the other colours of the garden cause high visual impact.

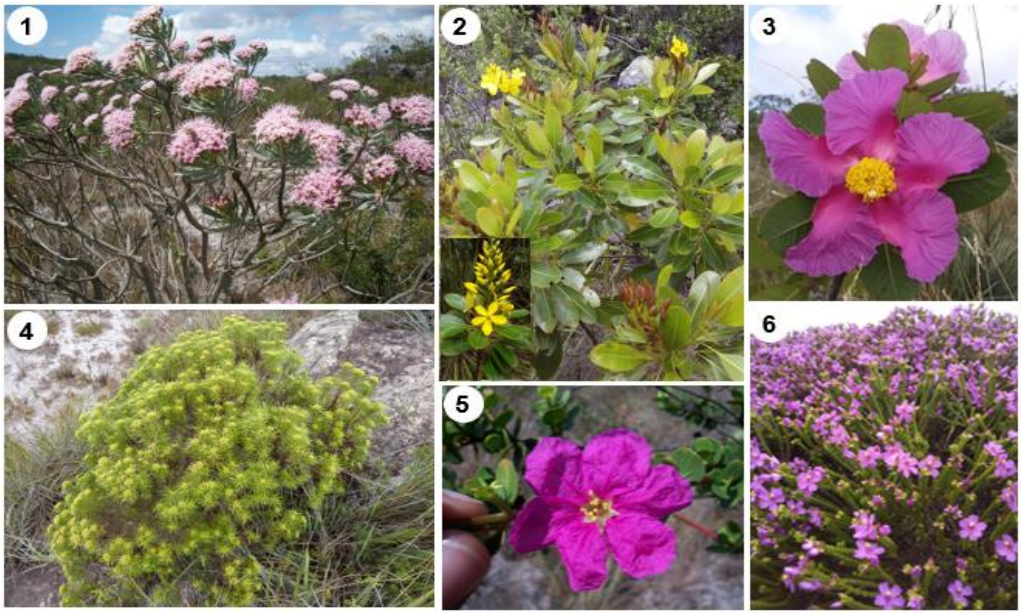

Figure 5. Shrub species with potential for use in gardens: 1. *Disynaphia praeficta*, 2. *Luxemburgia mogolensis*, 3. *Kielmeyera regalis*, 4. *Pseudobrickellia angustissima*, 5. *Diplusodon hirsutus*, and 6. *Microlicia tetrasticha*.

Stachytarpheta glabra (Figure 6) is suggested for cultivation as a hedge or mass flowers, or in containers under full sun. The architecture of this species does not require pruning since they already assume an ordered shape of the canopy. *Wunderlichia mirabilis* and *Sauvagesia elegantissima* (Figure 6) have an unusual and delicate appearance due to their architecture, the shape and colour of their leaves; in addition, their inflorescences contrast with their foliage, which makes these species recommended for the formation of small clusters with the rocks or as isolated plants highlighted in a garden.

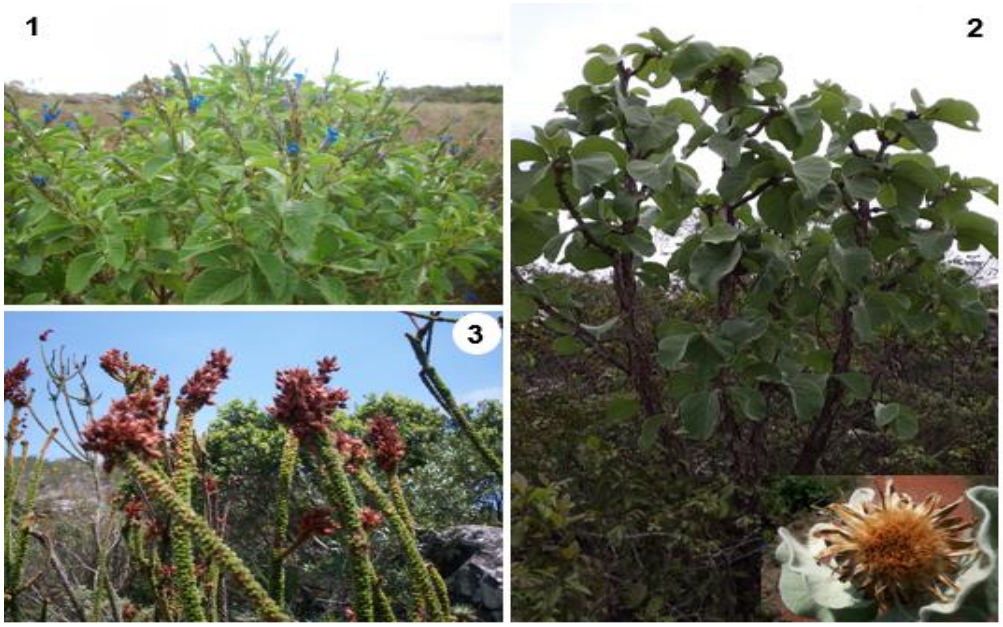

Figure 6. Shrub species with potential for use in gardens: 1. *Stachytarpheta glabra*, 2. *Wunderlichia mirabilis*, and 3. *Sauvagesia elegantissima*.

For the formation of borders and cultivation in pots, *Chamaecrista ramosa* stands out (Figure 7) due to its naturally symmetry and canopy with an ornamental architecture. It can serve as a potential substitute for exotic species that are already widespread, such as boxwood (*Buxus sempervirens*). *Euphorbia sarcodes*, and *Proteopsis argentea*, which also have the potential to be used as mass flowers (Figure 7).

Figure 7. Shrub species with potential uses in borders and pots: 1. *Chamaecrista ramosa, 2. Euphorbia sarcodes* and *3. Proteopsis argentea* and details of floral structures.

Figure 8. Shrub species with potential for cultivation in pots and borders in gardens: 1. *Stenandrium hatschbachii,* 2. *Cambessedesia hilariana,* 3. *Augusta longifolia,* 4. *Lavoisiera imbricata,* 5. *L. mellobarretoi,* 6. *Marcetia taxifolia,* 7. *Lippia bradei,* 8. *Vellozia maxillarioides,* and 9. *Aspilia foliosa.*

Among the studied shrubs, *Stenandrium hatschbachii, Cambessedesia hilariana, Marcetia taxifolia, Aspilia foliosa, Augusta longifolia, Lavoisiera imbricata, Vellozia maxillarioides* and *Lippia bradei* stands out (Figure 8). The ornamental potential of these species is supported by their unique small flowers with abundant colour combinations. Thus, they are recommended for planting in pots and planters, and in borders in full sunlight.

Species of Cactaceae, such as *Cipocereus minensis* and *Pilosocereus fulvilanatus* (Figure 9), can be planted directly in the soil in xerophytic gardens due to their appropriate ornamental and physiological characteristics. These plants can be cultivated alone, but it is also suggested to plant them in homogeneous masses to build patches of diversity in large gardens.

Figure 9. Species of the family Cactaceae with potential for use in xerophytic gardens: 1) *Pilosocereus fulvilanatus* and 2) *Cipocereus minensis*.

Twenty-three of the collected species have herbaceous habits and can be cultivated as garden ground cover plants, including *Evolvulus glomeratus, Lychnophora itacambirensis, Piriqueta duarteana, Portulaca hirsutissima, P. mucronata, Vellozia aloifolia* and *Barbacenia umbrosa* (Figure 10).

Figure 10. Herbaceous species with potential for use as ground cover plants: 1. *Evolvulus glomeratus* 2. *Portulaca mucronata*, 3. *Lychnophora itacambirensis* 4. *Vellozia aloifolia*, 5. *P. hirsutissima* 6. *Piriqueta duarteana*, and 7. *Barbacenia umbrosa*

The species indicated for cultivation in pots were *Drosera graomogolensis, Encholirium biflorum, Begonia grisea,* and *Mandevilla tenuifolia* (Figure 11).

Figure 11. Herbaceous species indicated for cultivation in pots: 1. *Encholirium biflorum*, 2. *Begonia grisea*, 3. *Mandevilla tenuifolia*, and 4. *Drosera graomogolensis.*

Among the vine species (Figure 12) both *Mandevilla semirii* and *Stipecoma peltigera* have the potential for cultivation in pots, use as ground cover, and use in hedgerows and even vertical gardens. *Mandevilla semirii* has large pink flowers and leaves with white veins, and

Stipecoma peltigera has peltate dark green leaves with reddish veins, and pink flowers that are appreciated in gardens, both with high ornamental potential.

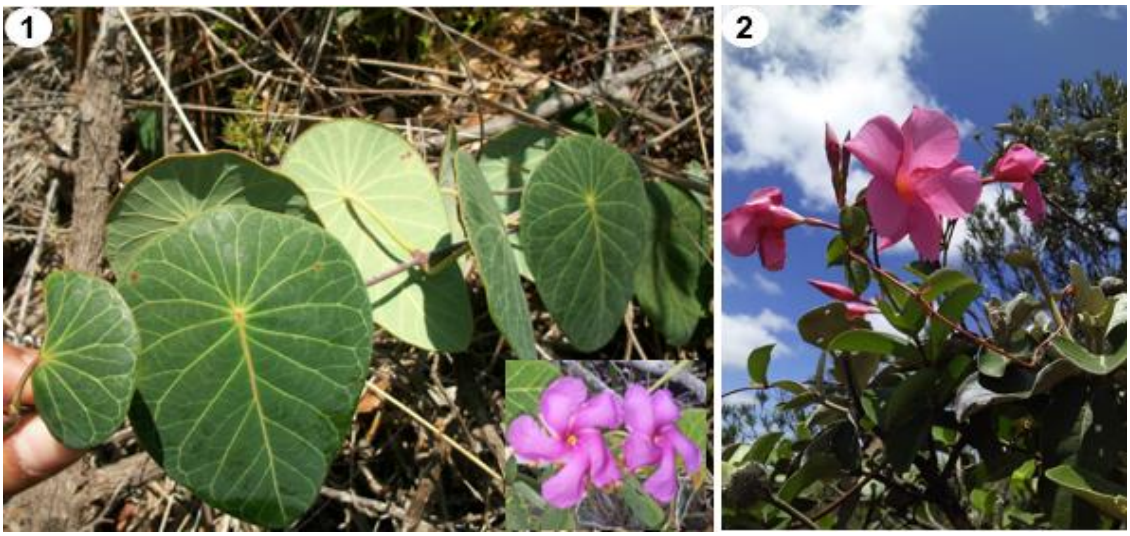

Figure 12. Vine species with potential for cultivation in pots and gardens: 1. *Stipecoma peltigera* and 2. *Mandevilla semirii*.

Eight of the studied species have desirable characteristics for sensory landscaping, especially in terms of touch: *Wunderlichia mirabilis, P. argentea, P. uliginosum, P. undulatum, S. elegantissima, C. dysantha,* and *C. asplenioides* (Table 2). Their leaves have various shapes, and the trichomes confer diverse textures. *Wunderlichia mirabilis* stands out for its thick and fissured stem and leaf trichomes, which allows a soft touch sensation. This velvety touch can also be observed in the flowers of the species of *Calliandra*, which have red stamens that draw much attention to the vegetation. In fact, leaves are the ideal organ for touch analysis because they present great morphological variety and are constant on the plants, since the flowers are restricted to the flowering phase[27].

Disynaphia praeficta, M. racemosa, Byrsonima sericea, K. regalis, and *A. puberula* (Table 2) have very pleasant and striking scent, and are consequently suggested for sensory gardens. The interaction of fauna with leaves, fruits and flowers produces several sounds, such as the singing of birds, the flight of bees, and due to the movement performed by the contact with the wind. Such sounds sharpen the sense of hearing, and the use of native species increases the chances of attracting this fauna[4]. Feeling the textures, scents, and sounds that nature offers

can cause sensations, allowing the landscaping to have a biophilic design, which means a closer relationship with nature, constituting an attraction for people who seek a more pleasant space in the urban environment. A diverse garden has effective elements to awaken the capacity for contemplation by all the senses, not only the vision[28] .

Species resistant to water deficit

Pseudobrickellia angustissima (Figura 4), *M. tetrasticha, V. maxillarioides, S. elegantissima, L. mogolensis* and *C. ramosa* (Figure 13) are species that have flowers and foliage appreciated because in addition to possessing remarkable flowering in the dry season, they maintain their ornamental characteristics even when they are in vegetative phase, due to the more open and symmetrical shape. In addition, the leaves of these plants are perennial and remain relatively lush green even in the dry season, which lasts approximately 6 months.

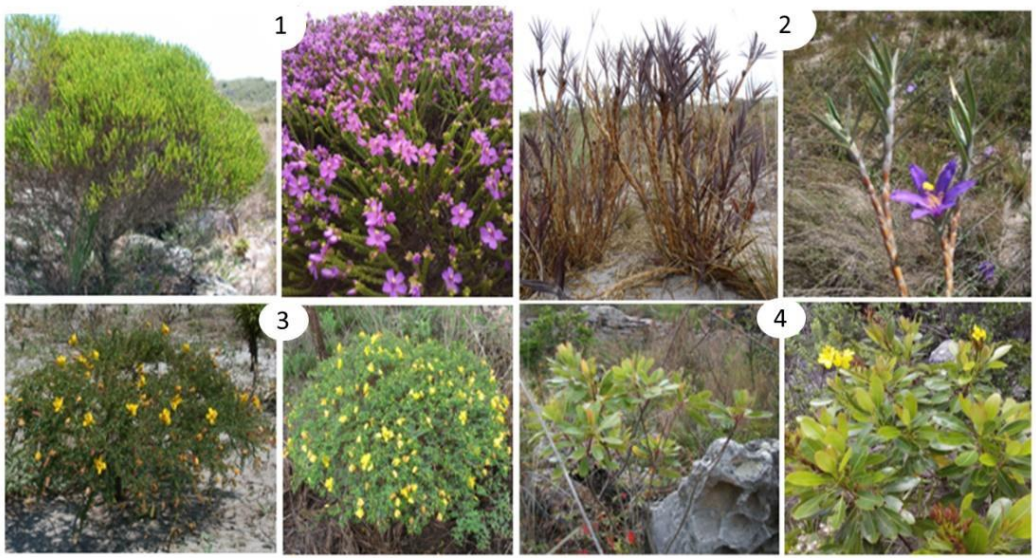

Figure 13. Species that present ornamental landscape attributes in the dry (left) and rainy (right) seasons: (1) *Microlicia tetrasticha*, (2) *Vellozia maxillarioides* (3) *Chamaecrista ramosa*, and (4) *Luxemburgia mogolensis.*

Even in periods where temperatures are higher (September to February) and there is no rainfall (between April and September)[16], these plants retain ornamental characteristics, which make them beneficial for use in landscaping. They are able to survive in environments with poor soil quality and high temperature fluctuations throughout the day and the year. Some of

the structures that make these plants adaptable to survive under drought conditions through the storage of water and nutrients are their underground reserve organs, such as the bulbs present in *Alstroemeria cunha* and *Hippeastrum morelianum* and the tuberous roots in *Mandevilla tenuifolia* (Figure 14).

Figure 14. Subterranean structure of *Mandevilla tenuifolia* and detail of flower (1). Detail of the whole plant with the tuberous root (2).

These underground organs are important for the survival of plants that lose their shoots in unfavorable periods, such as times of greater water restriction. For use in landscaping, it is recommended to use plant species with these subterranean structures together with other species that have a perennial shoot throughout the year. These perennial plants will fill the spaces of gardens when the other plants are dormant, forming the vegetation cover over the soil throughout the year. Thus, the flowering of these tuberous species that remained dormant will be a surprising element in the garden.

Another mechanism of drought resistance is the reduced leaf size, as identified in *S. elegantissima* (Figure 16 H), which has very small and densely clustered leaves along its stem, which in addition to conferring ornamental value, protects the plant against excessive water loss. This strategy also occurs in species of the genus *Lychnophora* and *Pseudobrickellia*. The presence of leaf trichomes also constitutes a morphological adaptation since these structures act by decreasing water loss, in addition to protecting the plant against predator attacks. These

structures are mainly present in *P. hirsutissima, W. mirabilis, B. grisea* and *P. argentea* (Figure 15).

Figure 15. Species with leaf trichomes: (1) *Wunderlichia mirabilis*, (2) *Proteopsis argentea*, (3) *Portulaca hirsutissima*, and (4) *Begonia grisea*.

Native species resilient to the dry season are valuable options for public gardens and squares that often have few resources for installing and maintaining irrigation systems, especially in regions where rainfall is low, such as the semiarid regions[29] . In gardens located in regions with high temperatures and low water availability, the use of exotic plants that demand large amounts of water causes lost of their full ornamental potential, when they are not irrigated according to their needs. In this case, the use of native species resistant to the edaphoclimatic conditions of the region decreases the costs with maintenance, which reduces the chances of compromising the ornamental value of these gardens during the dry season.

Ornamental species that have adaptive traits toward drought resistance, for instance, can be used to start sustainable landscaping projects, such as ecological, or naturalist gardens, that aim to preserve natural resources and develop more biodiverse environments. The use of plants naturally adapted to semiarid environments, may promote the conservation of water resources and favor an appreciation of the regional identity of gardens[30].

The other species of the rocky fields herein collected with such characteristics and potential use in gardens are *E. sarcodes, C. minensis, Pilosocereus fulvilanatus, E. biflorum, Actinocephalus bongardii, Syngonanthus verticillatus, L. itacambirensis, Paepalanthus eriophaeus, V. aloifolia, V. subscabra, V. maxillarioides, B. umbrosa, A. foliosa, C. obdeltifolia, M. tetrasticha,* and *S. elegantissima* (Figure 16).

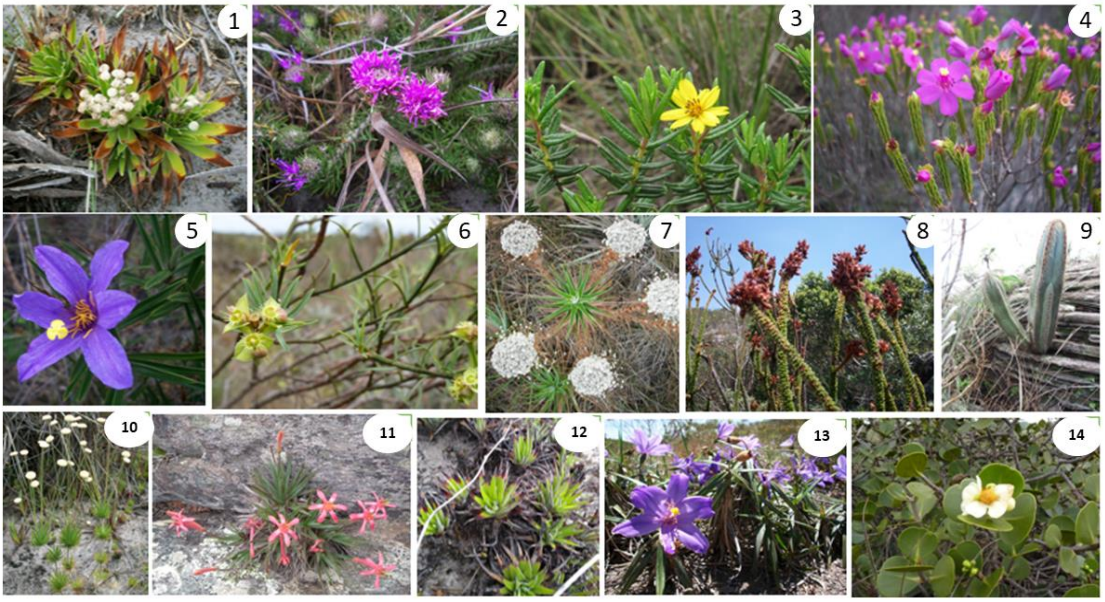

Figure 16. Species with ornamental potential and attributes for use in water-restricted gardens: (1) *Paepalanthus eriophaeus,* (2) *Lychnophora itacambirensis,* (3) *Aspilia foliosa,* (4) *Microlicia tetrasticha,* (5) *Vellozia aloifolia,* (6) *Euphorbia sarcodes,* (7) *Actinocephalus bongardii,* (8) *Sauvagesia very elegant,* (9) *Pilosocereus fulvilanatus,* (10) *Syngonanthus verticillatus,* (11) *Barbacenia umbrosa,* (12) *Encholirium biflorum* (13) *V. subscabra,* and (14) *Clusia obdeltifolia*

The diversity of the species collected at Serra do Itacambira was related to the formation of the microhabitats and the substrate where the plant groups grew; i.e., each microenvironment provides particular characteristics, such as accumulation of organic matter and water saturation, which influence plant characteristics. Nevertheless, some species of the genera: *Begonia, Mandevilla, Thaumatophyllum, Proteopsis, Vellozia, Wunderlichia, Stachytarpheta, Sauvagesia, Luxemburgia, Calliandra,* and *Aspilia* did not show any preference regarding

substrate conditions, occurring in both dry, humid rocky fields, and rock crevices, indicating possible hardiness characteristics.

Throughout the sampling period at the Serra de Itacambira, some species flowered even in the very dry period, which lasts approximately 6 months. The flowering phase, in addition to being a well-appreciated aesthetic feature in landscaping, is important for interactions with the local fauna, as pollinator attraction, for instance. The use of these species in building green areas can ensure the restoration and maintenance of important ecological agents such as bees and birds, as these plants provide food and shelter, contributing to the increase in biodiversity[31] even in urban environment. Species, such as *M. tetrasticha*, whose flowers are the main ornamental structure, maintain its ornamental appearance even in the absence of flowers and in the dry season, due to their beautiful green leaves, a characteristic observed in all genera of the Melastomataceae collected in the area.

Native plants can be used in landscaping for the benefit they bring to the local fauna. Species that have fruits may offer food resources, and their seeds can be dispersed. As an example, the palatable fruits of *Tococa guianensis* attract birds that are the main dispersers of its seeds[32]. *Schwartzia adamantium* has extrafloral nectaries that are attractive to small predatory insects due to the availability of nectar. These predatory insects are natural enemies of other pests, promoting a beneficial interaction[33] and biological control in gardens, an important ecological service for the balance of the ecosystem.

Regarding the commercial applicability, the characteristics presented by all studied species indicate their use in landscaping, however, researching efforts are needed on propagation and legalization of these species for commercial purposes, so that the seedlings are safely available on the market, without harming the ecosystem where they exist.

CONCLUSIONS

Rocky field of the Serra da Itacambira has a great diversity of species with desirable ornamental and sensory attributes for use in landscape projects. The flowers, leaves, and stems of the described species have aesthetic characteristics with ornamental potential for several uses in landscaping. The species studied also present, in addition to characteristics that confer

resistance to high temperatures and water deficit, interactions with the local fauna, which enables their use in ecological landscaping with biophilic design.

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REFERENCES

1. STUMPF, Elisabeth Regina Tempel et al. Espécies nativas que podem substituir as exóticas no paisagismo. Ornamental Horticulture, v.21, n.2, p.165-172, 2015
2. NG, Casey Keat-Chuan. The Avifauna-Based Biophysical Index (ABI) approach for assessing and planning ecological landscaping in tropical cities. Urban Forestry & Urban Greening**,** 2020. DOI: https://doi.org/10.1016/j.ufug.2020.126850.
3. THOREN, Roxi. Landscapes of change: innovative designs and reinvented sites. Portland: Timber Press.ng, B., Xie, G.D., Li, N., Wang, S. Effect of urban green space changes on the role of rainwater runoff reduction in Beijing, China. Landscape and Urban Planning, v.140, p.8-16, 2014. DOI: https://doi.org/10.1016/j.landurbplan.2015.03.014.
4. JUNQUEIRA, Antonio Hélio, Peetz, Márcia Da Silva. Sustainability in Brazilian floriculture: introductory notes to a systemic approach. Ornamental Horticulture, 24(2):155- 162, 2018. DOI: https://doi.org/10.14295/oh.v24i2.1253.
5. HEIDEN, Gustavo et al. Considerações sobre o uso de plantas ornamentais nativas. Revista Brasileira de Horticultura Ornamental, 12(1): 2-7, 2006. DOI: https://doi.org/10.14295/rbho.v12i1.60.
6. FISCHER, Síntia Zitzke et al. Plantas da flora brasileira no mercado internacional de floricultura. Revista Brasileira de Biociências, 5:510-512, 2007.
7. HEIDEN, Gustavo. Uso de plantas arbóreas e arbustivas nativas do Rio Grande do Sul como alternativa a ornamentais exóticas. Revista Brasileira de Agroecologia, 2(1):1-4, 2007.
8. BRASIL, Ministério do Meio Ambiente. O Bioma Cerrado. 2020. Disponível em: <https://www.mma.gov.br/biomas/Cerrado >. Acesso em: 04 de setembro de 2020.
9. RIBEIRO, José Felipe, WALTER, Bruno Machado Teles. Fitofisionomias do bioma cerrado. Pp. 89-166. In: S.M. Sano & S.P. Almeida (eds.). Cerrado: ambiente e flora. Planaltina, Embrapa-CPAC, 1998.
10. ALVES, Ruy José Válka et al. Circumscribing campos rupestres – megadiverse Brazilian rocky montane savannas. Brazilian Journal of Botany, 74: 355–362, 2014. DOI 10.1590/1519-6984.23212.
11. SILVEIRA, Fernando Augusto de Oliveira et al. Ecology and evolution of plant diversity in the endangered campo rupestre: a neglected conservation priority. Plant

Soil, 403: p. 129-152, 2016. DOI: https://doi.org/10.1007/s11104-015-2637-8.
12. CORADIN, Lidio. Perspectivas e recomendações. In: CORADIN, L., SIMINSKI, A.; REIS, A. Espécies nativas da flora brasileira de valor econômico atual ou potencial: plantas para o futuro – região sul. Brasil. Ministério do Meio Ambiente/Secretaria de Biodiversidade e Florestas. Série Biodiversidade 40. Brasília: MMA, p.25-64, 2011.
13. RIBEIRO Patrícia Luz et al., Genetic and morphological diversity and evidence of hybridization in the "sempre-vivas" (Comanthera, Eriocaulaceae) endemic to the Chapada Diamantina, Bahia, Brazil. Flora, 2018, 238, pp. 60-71, 2018. DOI: https://doi.org/10.1016/j.flora.2017.09.013.
14. SANTOS, Bethânia Gabrielle dos, BRANQUINHO, Fátima Teresa Braga. Humanos, sempre-vivas e outros-que-não-humanos: coletando e compondo o mundo comum no Espinhaço Meridional-MG. Anuário Antropológico, v. 45, n. 3, p. 44-63, 2020. DOI: https://doi.org/10.4000/aa.6591.
15. ALVAREZ, Clayton Alcarde et al. Köppens's climate classification map for Brazil. Meteorologische Zeitschrift, 22(6):711-728, 2013. DOI 10.1127/0941-2948/2013/0507
16. CLIMATE-DATA. Clima. Disponível em:<https://pt.climate-data.org/> Acesso em: 4 jan de 2021.
17. CHAMAS, Cintia Costa, MATTHES Luiz Antonio Ferraz. Método para levantamento de espécies nativas com potencial ornamental. Ornamental Horticulture, (6)1:53-63,
18. MORI, S.A et al. Manual de Manejo do Herbário Fanerogâmico. Ilhéus: Centro de Pesquisas do Cacau, 103p, 1989.
19. FLORA DO BRASIL 2020. Base de dados Flora do Brasil 2020. Jardim Botânico do Rio de Janeiro. Disponível em: <floradobrasil.jbrj.gov.br>. Acesso em: 25 de jan de
20. STUMPF, Elisabeth Regina Tempel, et al. Características ornamentais de plantas do Bioma Pampa. Revista Brasileira de Horticultura Ornamental, 15: 49-62, 2009. DOI: https://doi.org/10.14295/rbho.v15i1.435.
21. PIRANI, Flávia Richelli, et al. Fenologia de uma comunidade arbórea em cerrado sentido restrito, Barra do Garças, MT, Brasil. Acta botânica brasilica, v. 23, n. 4, p. 1096-1109, 2009. DOI: https://doi.org/10.1590/S0102-33062009000400019.
22. BARROSO, Cecília Maciel et al. Considerações sobre a propagação e o uso ornamental de plantas raras ou ameaçadas de extinção no Rio Grande do Sul, Brasil. Ornamental Horticulture, 13 (2):91-94, 2007. DOI: https://doi.org/10.14295/rbho.v13i2.210.
23. MINISTÉRIO DO MEIO AMBIENTE, Portaria MMA, nº 148, de 07 de junho de 2022. Disponível em: <https://www.icmbio.gov.br/cepsul/images/stories/legislacao/Portaria/2020/P_mma_148_2022_altera_anexos_P_mma_443_444_445_2014_atualiza_especies_ameacadas_extincao.pdf>. Acesso em: 07 de agosto de 2023.
24. PAULA, Eline Silva de et al. A paisagem da caatinga: um gesto de Burle Marx na Praça Euclides da Cunha. Revista Paisagem e Ambiente, São Paulo, n.29, p. 11-24, 2011. DOI: https://doi.org/10.11606/issn.2359-5361.v0i29p11-24.
25. REFLORA. 2020. Herbário Virtual. Jardim Botânico do Rio de Janeiro. Disponível em: http:/floradobrasil.jbrj.gov.br. Último acesso em 15 jan 2021.
26. CAVALCANTE, Markilla Zunete Beckmann et al. Potencial ornamental de espécies do Bioma Caatinga. Comunicata Scientiae, 8(1):43-58, 2017. DOI: 10.14295/CS. v8i1.2649.
27. MENEZES, Cristiane Rodrigues, HARDOIM, Edna Lopes. Identificação, seleção e

caracterização das espécies vegetais destinadas ao Jardim Sensorial Tumucumaque, município de Serra do Navio, AP/Brasil. Biota Amazônia, 3(1): 22-30. ISSN 2179-5746, 2013. DOI: http://dx.doi.org/10.18561/2179-5746.
28. LEÃO, José Flávio Machado César. Identificação, seleção e caracterização de espécies vegetais destinadas à instalação de jardins sensoriais táteis para deficientes visuais, em Piracicaba (SP). Ornamental Horticulture, 14(2):135-146, 2008. DOI: https://doi.org/10.14295/rbho.v14i2.283.
29. OLIVEIRA-JUNIOR Clovis Jose Fernandes et al. Potencial das espécies nativas na produção de plantas ornamentais e paisagismo agroecológico. Revista Brasileira de Agroecologia, v. 8, n. 3, p. 190-200, 2013.
30. MEIRA, Manoel Messias Coutinho et al. A beleza seca: aspectos do paisagismo no semiárido brasileiro. Revista MIX Sustentável, 3(2), 108-113, 2017. DOI: https://doi.org/10.29183/2447-3073.MIX2017.v3.n2.108-113
31. BRUN, Flávia Gizele König. O emprego da arborização na manutenção da biodiversidade da fauna em áreas urbanas. Revista da Sociedade Brasileira de Arborização Urbana, 2(1):117-124, 2007.
32. MICHELANGELI, Fabian Armando. A monograph of Tococa Aublet (Melastomataceae). Flora Neotropica Monographs, 98, 1-114, 2005.
33. NASCIMENTO, Kariny Cari, BARBOSA, José Felinto. Caracterização morfoanatômica de nectários extraflorais de Passiflora alata, Passifloraceae. Uningá Review, v. 20, n. 1, p. 45-55, 2014.