

Flora at risk in the plant communities of the Ciénaga de La Palmita, Zulia State, Venezuela

Flora en riesgo de las comunidades vegetales de la Ciénaga de La Palmita, Estado Zulia, Venezuela

Flora em risco nas comunidades vegetais da Ciénaga de La Palmita, Estado Zulia, Venezuela



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Abstract

An inventory of the endangered flora of the deciduous thorny xerophytic shrublands and mangrove forest was conducted in the Wildlife Fauna Reservoir Ciénaga de La Palmita and Isla de Pájaros, Zulia State, Venezuela. The research was carried out through 10 sampling events, plots of 400 m² and 1000 m², and field explorations (2021-2022). The species were classified according to the Red Book of Venezuelan Flora, identifying 23 species and 16 families, grouped into the following categories: Vulnerable (VU) 4 spp., Near Threatened (NT) 8 spp., Least Concern (LC) 8 spp., and Data Deficient (DD) 3 spp. The Cactaceae family had the highest number of species at risk (3), including *Acanthocereus tetragonus*, *Leuenbergeria guamacho*, and *Melocactus curvispinus*, the latter two being listed as Vulnerable. Only one individual of *Pseudalbizzia niopoides* var. *colombiana* (Fabaceae), listed as Vulnerable, was recorded. The mangroves *Avicennia germinans* and *Rhizophora mangle* were listed as Near Threatened, and *Conocarpus erectus* was designated as Least Concern. Additionally, taxa endemic to Venezuela, *Bromelia humilis* (Bromeliaceae) and *Evolvulus villosissimus* (Convolvulaceae), were found to be Near Threatened and Data Deficient, respectively, due to fires, harvesting for ornamental purposes, and restricted distribution. The medicinal trees *Guaicum officinale* and *Pterocarpus officinalis* were listed as Vulnerable and Least Concern, respectively. The orchid *Encyclia cordigera* was classified as Near Threatened. It was concluded that the number of at-risk species is increasing in the studied Wildlife Fauna Reservoir (ABRAE) due to anthropogenic disturbances currently threatening its flora.

Resumen

Se realizó el inventario de la flora en riesgo de los arbustales xerófilos espinosos deciduos y el bosque de manglar en la Reserva de Fauna Silvestre Ciénaga de La Palmita e Isla de Pájaros, Estado Zulia, Venezuela. La investigación se hizo a través de 10 muestreos, parcelas de 400 m² y 1000 m² y exploraciones de campo (periodo 2021-2022). Las especies se clasificaron según el Libro Rojo de la Flora Venezolana, identificándose 23 especies y 16 familias, agrupadas en las categorías: Vulnerable (VU) 4 spp., Casi Amenazada (NT) 8 spp., Preocupación Menor (LC) 8 spp. y Datos Insuficientes (DD) 3 spp. La familia Cactaceae reunió el mayor número de especies en riesgo (3) con *Acanthocereus tetragonus*, *Leuenbergeria guamacho* y *Melocactus curvispinus*, destacando las dos últimas como Vulnerables; mientras que de *Pseudalbizzia niopoides* var. *colombiana* (Fabaceae), catalogada como Vulnerable, se censó solo un individuo. Los mangles *Avicennia germinans* y *Rhizophora mangle* se registraron como Casi Amenazadas y *Conocarpus erectus* fue designada en Preocupación Menor. Además, se encontraron taxones endémicos para Venezuela, *Bromelia humilis* (Bromeliaceae) y *Evolvulus villosissimus* (Convolvulaceae) como Casi Amenazada y de Datos Insuficientes respectivamente, relacionado con quemas, extracción para fines ornamentales y distribución restringida. Los árboles *Guaicum officinale* y *Pterocarpus officinalis*, de uso medicinal, se catalogaron Vulnerable y de Preocupación Menor respectivamente; y la orquídea *Encyclia cordigera* se clasificó como Casi Amenazada. Se concluyó que las especies en riesgo aumenten en la Reserva de Fauna Silvestre (ABRAE) estudiada, debido a las perturbaciones antropogénicas que actualmente atentan contra su flora.

Palabras clave: arbustales xerófilos espinosos deciduos, Lago de Maracaibo, Libro Rojo de la Flora Venezolana, manglar, Reserva de Fauna Silvestre.

Resumo

Foi realizado um inventário da flora ameaçada de extinção dos arbustais xerófitos espinhosos decíduos e do manguezal na Reserva de Vida Selvagem Ciénaga de La Palmita e Isla de Pájaros, no estado de Zulia, Venezuela. A pesquisa foi conduzida por meio de 10 eventos de amostragem, em parcelas de 400 m² e 1000 m², e explorações de campo (2021-2022). As espécies foram classificadas de acordo com o Livro Vermelho da Flora Venezuelana, identificando-se 23 espécies e 16 famílias, agrupadas nas seguintes categorias: Vulnerável (VU) 4 spp., Quase Ameaçada (NT) 8 spp., Pouco Preocupante (LC) 8 spp. e Dados Insuficientes (DD) 3 spp. A família Cactaceae apresentou o maior número de espécies em risco (3), incluindo *Acanthocereus tetragonus*, *Leuenbergeria guamacho* e *Melocactus curvispinus*, sendo as duas últimas classificadas como Vulneráveis. Apenas um indivíduo de *Pseudalbizzia niopoides* var. *colombiana* (Fabaceae), classificada como Vulnerável, foi registrado. Os manguezais *Avicennia germinans* e *Rhizophora mangle* foram classificados como Quase Ameaçados, e *Conocarpus erectus* foi classificado como Pouco Preocupante. Além disso, os táxons endêmicos da Venezuela, *Bromelia humilis* (Bromeliaceae) e *Evolvulus villosissimus* (Convolvulaceae), foram classificados como Quase Ameaçada e com Dados Insuficientes, respectivamente, devido a incêndios, coleta para fins ornamentais e distribuição restrita. As árvores medicinais *Guaicum officinale*

e *Pterocarpus officinalis* foram classificadas como Vulneráveis e Pouco Preocupantes, respectivamente. A orquídea *Encyclia cordigera* foi classificada como Quase Ameaçada. Conclui-se que o número de espécies em risco está aumentando na Reserva de Vida Selvagem estudada (ABRAE) devido a perturbações antropogênicas que atualmente ameaçam sua flora.

Palavras-chave: matagais xerófilos espinhosos decíduos, Lago Maracaibo, Livro Vermelho da Flora Venezuelana, manguezal, Reserva de Vida Selvagem.

Introduction

The International Union for Conservation of Nature (IUCN) has estimated that around 43,000 plant species have declined in number and/or geographic distribution, and are currently threatened with extinction (IUCN, 2020). This loss has been accentuated in practically all ecosystems on the planet due to human activities such as agricultural and urban land use (Tachack-García & Rodríguez, 2020).

The second edition of the Red Book of Venezuelan Flora was published in the country in 2020; it is a work that compiles the scientific knowledge available on the nation's flora and its conservation status. This has been considered absolutely necessary and important given the marked reduction experienced by plant populations as a result of the environmental degradation of different natural ecosystems (Huérffano *et al.*, 2020). In addition, there are investigations that have revealed the different states of risk in which the national flora is found, located in different wild plant formations that make up the Venezuelan phytogeography.

In this regard, Lárez & Prada (2014) inventoried 19 threatened species and classified them as Critically Endangered (CR) 1 sp., Endangered (EN) 3 spp., and Vulnerable (VU) 15 spp. in the Deltaic Plain of Monagas State.

Meanwhile, Bello (2020) reported 23 species categorized as Endangered (EN) 1 sp., Vulnerable (VU) 7 spp., Near Threatened (NT) 6 spp., Least Concern (LC) 6 spp., and Data Deficient (DD) 3 spp. for the semi-arid corridor on the northern slope of the Araya Peninsula, Sucre State.

Similarly, Bello *et al.* (2020) recorded 12 taxa in the categories of Endangered (1 sp.), Vulnerable (4 spp.), Near Threatened (3 spp.) and Least Concern (4 spp.) for the Parque Litoral Punta Delgada of Cumaná, Sucre State; and Vera (2023) pointed out 6 species considered to be Endangered (1 sp.) and Vulnerable (5 spp.) in the xerophytic relicts of the ciudad universitaria "Antonio Borjas Romero" of the Universidad del Zulia, Maracaibo, Zulia State.

On the other hand, there are arguments that highlight the need for and importance of conducting research such as this one, pointing to the fifth historical objective of the Plan de la Patria (Homeland Plan), which includes carrying out basic and interpretive studies of vegetation and ecosystems; protecting Areas Under Special Administration Regime (ABRAE); systematizing the monitoring of biodiversity, conservation activities, scientific study, and the dissemination of information about the flora in these protected wild natural areas (Gobierno Bolivariano de Venezuela, 2025).

Likewise, some of the Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development refer to ensuring the restoration and use of terrestrial ecosystems, halting deforestation, restoring degraded forests, increasing reforestation, controlling

biodiversity loss, protecting threatened species, and preventing their extinction (Asamblea General de la Naciones Unidas, 2015).

The Ciénaga de La Palmita is located on the eastern shore of the Maracaibo Lake strait, in Zulia State, Venezuela. It was declared an Area Under Special Administration Regime (ABRAE) and designated as a Wildlife Fauna Reservoir (Reserva de Fauna Silvestre; RFS) on March 9, 2000, with the objective of conserving the habitat of numerous bird species, protect game species and endangered species (Gaceta Oficial de la República Bolivariana de Venezuela, 2000). However, little research has been conducted on the biota in general within this ABRAE, and there are no studies on the threatened status of its flora, despite the fact that this protected natural area is currently subject to disturbances that significantly threaten its biodiversity and ecosystem stability (Vera, 2022).

When the Ciénaga de La Palmita was declared a Wildlife Fauna Reservoir (Reserva de Fauna Silvestre; RFS) in 2000, 25 years ago, there was already evidence of disturbances impacting the wildlife of this large biotic area (Gaceta Oficial de la República Bolivariana de Venezuela, 2000). This underscores the importance and necessity of developing studies that contribute scientific knowledge about the condition of part of the floristic component of this protected area.

The objective of this research was to inventory the flora at risk in the plant communities of the Ciénaga de La Palmita, Zulia State, Venezuela, according to the criteria of the Red Book of Venezuelan Flora.

Materials and methods

The research was conducted in the Wildlife Fauna Reservoir Ciénaga de La Palmita and Isla de Pájaros, located on the eastern shore of the Maracaibo Lake strait, Zulia State, Venezuela (10° 35' 12"-10° 38' 23" N and 71° 26' 41"-71° 31' 15" W), specifically in the deciduous thorny xerophytic shrublands of the southern area of said Wildlife Fauna Reservoir (10° 35' 46.0" N and 71° 30' 09.0" W) and in those of the small xerophytic enclave called El Hicacal Islet (10° 36' 53" N and 71° 29' 42" W) (Vera, 2024).

The study was also conducted in the mangrove forest, dominated by *Rhizophora mangle* L., adjacent to La Palmita Cove (10° 36' 55.8" N and 71° 29' 59.1" W), in the communities of *Conocarpus erectus* L. and *Laguncularia racemosa* (L.) C.F.Gaertn. near the shores of the swamp itself (10° 37' 859" N and 71° 28' 651" W), and in the lateral ridge of *Avicennia germinans* (L.) L. in the northern part of the Wildlife Fauna Reservoir (10° 37' 48.2" N and 71° 28' 49.6" W). The entire study area is subject to the semi-arid conditions of the Very Dry Tropical Forest (b-MST) life zone according to Ewel and Madriz (1968). The average temperature ranges from 27.8 to 28.3 °C, and precipitation ranges from 400 to 500 mm, with a bimodal rainfall pattern.

The surveys and field explorations were conducted from September 2021 to April 2022, covering both the rainy and dry seasons. Plots of 50 x 20 m (1000 m² = 0.1 ha) were also delineated in the deciduous thorny xerophytic shrublands, and 20 x 20 m (400 m²) plots were established in the different areas where mangrove vegetation was inventoried.

The species were cataloged according to the classification categories of the Red Book of Venezuelan Flora (Huérffano *et al.*, 2020). Taxonomic identification was carried out in the field, with the guidance of taxonomist botanists, and based on the comparison of the collected botanical samples with existing material preserved from the

Omar Zambrano HERZU herbarium of the Facultad de Agronomía of the Universidad del Zulia. The nomenclature of the World Flora Online Plant List (2025) was used in the updating of the epithets.

Results and discussion

The floristic study identified 23 species at risk, grouped into 16 botanical families, in the plant communities of the Wildlife Fauna Reservoir Ciénaga de La Palmita and Isla de Pájaros, according to the Red Book of Venezuelan Flora (Huérffano *et al.*, 2020), Table 1.

The species at risk consisted of 20 dicotyledons and 3 monocotyledons. Regarding their life habit (biotype), they were classified as trees (15), herbs (3), shrubs (2), epiphyte (1), stipe (1), and climber (1), Table 1. According to the Red Book of Venezuelan Flora, the species fell into four of the ten current categories of the International Union for Conservation of Nature (IUCN), highlighting 4 species classified as Vulnerable (VU), 8 species as Near Threatened (NT), 8 species as Least Concern (LC), and 3 species as Data Deficient (DD), Table 1 (Huérffano *et al.*, 2020).

In general, the plant communities of the Wildlife Fauna Reservoir under study have been subjected to stressors and disturbances that threaten the conservation of their natural resources and ecosystem stability, such as agricultural and livestock activities, human occupation, reduced water flow to the swamp, habitat fragmentation, logging, and burning (Medina & Barboza, 2006; Vera, 2022; Vera, 2024).

The species included in the Vulnerable (VU) category were *Pseudalbizzia niopoides* var. *colombiana* (Britton) E.J.M.Koenen & Duno, *Guaiacum officinale* L., *Leuenergeria guamacho* (F.A.C. Weber) Lodé, and *Melocactus curvispinus* Pfeiff., Table 1. It is worth noting that the situation of *P. niopoides* var. *colombiana* (niobe albizia) was truly worrisome, as only one 5 m tall individual was recorded in the deciduous thorny xerophytic scrublands of El Hicacal Islet. This result was explained by the findings of Huérffano *et al.* (2020), who reported that this legume is subject to logging and lacks specific conservation measures, such as seed preservation, which has led to a decrease in the number of standing individuals (Huérffano *et al.*, 2020). All of these factors may have contributed to the decrease in the population density of this legume in the investigated ABRAE.

Eight individuals of *G. officinale* (lignum-vitae) were counted, and their low abundance was linked to logging, habitat destruction, the development of urban and agricultural activities, and the centuries-long commercialization of its resin, used for medicinal purposes and obtained from the stem, Table 1 (Hoyos, 1985; Huérffano *et al.*, 2020). Lignum-vitae is also on the IUCN Red List classified as Endangered and included in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (IUCN, 2020; CITES, 2025).

Added to this, is the slow growth of *G. officinale* which delays its development until it reaches larger adult sizes (Hoyos, 1985; Huérffano *et al.*, 2020).

Regarding the species *L. guamacho* (guamacho), a greater number of individuals were observed compared to *P. niopoides* var. *colombiana* and *G. officinale*. This was associated with the adaptive capacity of cacti to arid and semi-arid environments, making them index species for the deciduous thorny xerophytic shrublands of the Wildlife Fauna Reservoir under study. The deciduous nature of *L. guamacho* during drought also contributes to this, serving as a mechanism to avoid excessive water loss and thus increase its survival.

Table 1. Flora at risk in the plant communities of the Wildlife Fauna Reservoir Ciénaga de La Palmita and Isla de Pájaros, Zulia State, Venezuela.

Family	Species	Common name	Biotype	Category ^a	Plant community	N° of individuals
Acanthaceae	<i>Avicennia germinans</i> (L.) L.	black mangrove	Tree	NT	Mangrove	18
Anacardiaceae	<i>Astronium graveolens</i> Jacq.	glassywood	Tree	LC	Dtxs ^{ef}	12-12
Arecaceae	<i>Copernicia tectorum</i> (Kunth) Mart.	sará palm	Stipe	LC	Dtxs ^f	2
Bignoniaceae	<i>Handroanthus serratifolius</i> (Vahl) S.O.Grose	yellow ipê	Tree	NT	Dtxs ^e	4
	<i>Roseodendron chryseum</i> (S.F.Blake) Miranda	gold tree	Tree	NT	Dtxs ^e	2
Bromeliaceae	<i>Bromelia humilis</i> ^d Jacq.	dwarf bromelia	Herb	NT	Dtxs ^{ef}	35-40
Burseraceae	<i>Bursera simaruba</i> (L.) Sarg.	gumbo-limbo	Tree	LC	Dtxs ^{ef}	6-10
Cactaceae	<i>Acanthocereus tetragonus</i> (L.) Hummelinck	barbed-wire cactus	Shrub	LC	Dtxs ^{ef}	6-47
	<i>Melocactus curvispinus</i> Pfeiff.	turk's cap cactus	Herb	VU	Dtxs ^e	7
	<i>Leuenergeria guamacho</i> (F.A.C.Weber) Lodé	guamacho	Tree	VU	Dtxs ^{ef}	29-37
Combretaceae	<i>Conocarpus erectus</i> L.	button mangrove	Tree	LC	Mangrove	30
	<i>Terminalia catappa</i> L.	indian-almond	Tree	DD	Mangrove	3
Convolvulaceae	<i>Evolvulus villosissimus</i> ^d Ooststr.	shaggy dwarf morning-glory	Herb	DD	Dtxs ^f	3
	<i>Ipomoea chenopodiifolia</i> (M.Martens & Galeotti) Hemsl.	morning glory	Climber	DD	Dtxs ^e	6
Euphorbiaceae	<i>Croton hostmannii</i> Miq.	croton	Shrub	LC	Dtxs ^f	3
Fabaceae	<i>Pseudalbizzia niopoides</i> var. <i>colombiana</i> (Britton)	niobe albizia	Tree	VU	Dtxs ^f	1
	E.J.M.Koenen & Duno					
	<i>Pterocarpus officinalis</i> Jacq.	dragonsblood tree	Tree	LC	Mangrove	3
Opiliaceae	<i>Agonandra brasiliensis</i> Benth & Hook.f.	ivory wood tree	Tree	NT	Dtxs ^e	2
Orchidaceae	<i>Encyclia cordigera</i> (Kunth) Dressler	butterfly orchid	Epiphyte	NT	Dtxs ^e	6
Rhizophoraceae	<i>Rhizophora mangle</i> L.	red mangrove	Tree	NT	Mangrove	16
Sapotaceae	<i>Sideroxylon obtusifolium</i> subsp. <i>obtusifolium</i> (Roem. & Schult.) T.D.Penn.	jungle plum	Tree	LC	Dtxs ^e	2
Zygophyllaceae	<i>Guaiacum officinale</i> ^{bc} L.	lignum vitae	Tree	VU	Dtxs ^{ef}	3-5
	<i>Plectrocarpa arborea</i> (Jacq.) Christenh. & Byng	vera wood	Tree	NT	Dtxs ^{ef}	3-1

^aCategory of the current and international registry of the Red Book of Venezuelan Flora and of the International Union for Conservation of Nature (IUCN) VU= Vulnerable, NT= Near Threatened, LC= Least Concern, DD= Data Deficient; ^bSpecies on the IUCN Red List, classified as “Endangered”; ^cSpecies included in Appendix II of CITES (2025) (Convention on International Trade in Endangered Species of Wild Fauna and Flora); ^dEndemic species; ^eDtxs= Deciduous thorny xerophytic shrublands in the southern area of the Wildlife Fauna Reservoir; ^fDtxs= Deciduous thorny xerophytic shrublands of El Hicacal Islet; N° of individuals= when two numerical values appear, the first corresponds to the southern sector of the Wildlife Fauna Reservoir and the second to El Hicacal Islet.

Sánchez-Urdaneta *et al.* (2022) noted that *L. guamacho* was the fourth taxon with the highest number of specimens (123) in the Cactaceae collections of the nine (9) main herbaria in Venezuela, indicating that it is a species with a considerable relative abundance of individuals.

In Zulia, *L. guamacho* has been reported in the xerophytic forest of the Las Peonías region in Maracaibo, in the semi-deciduous forests on the Palmar River floodplain, in the disturbed thorny xerophytic scrubland of Punta de Piedras, Miranda municipality, on the eastern shore of Lake Maracaibo, and in the xerophytic vegetation of the Maracaibo Botanical Garden (González, 1980; Fernández *et al.*, 2007; Vera *et al.*, 2009; Rivera *et al.*, 2022).

Despite these characteristics and its wide distribution in Venezuela, “guamacho” populations are threatened, and some have been eliminated due to the increase in human settlements (Huérfino *et al.*, 2020).

The cactus *M. curvispinus* (Turk’s cap cactus) is a globose herb, found in only a few areas of the deciduous thorny xerophytic shrublands in the southern area of the reservoir under study, and represented by specimens growing only 15 cm above the ground, Table 1. The low number of individuals is due to the impacts or disturbances

experienced by the plant communities of this ABRAE, which in turn is linked to the report by Huérfino *et al.* (2020) on environments with highly fragmented vegetation, low-lying thorny scrublands with few well-developed trees where *M. curvispinus* grows.

However, *Melocactus* is the second most representative genus of the Cactaceae family in Venezuela with 10 species, according to Sánchez-Urdaneta *et al.* (2022). This finding reflects the need and importance of protecting and safeguarding the biological integrity of cactus species in the country.

The species *Agonandra brasiliensis* Benth & Hook.f., *A. germinans* (black mangrove), *Bromelia humilis* Jacq., *Plectrocarpa arborea* (Jacq.) Christenh. & Byng, *Encyclia cordigera* (Kunth) Dressler, and *R. mangle* (red mangrove) were recorded under the Near Threatened (NT) category, Table 1, which groups taxa not considered Critically Endangered, Endangered, or Vulnerable. However, these species are very close to being included in one of these threat categories (Huérfino *et al.*, 2020). Therefore, the Venezuelan state is urged to implement actions to halt the risk posed by these taxa.

The black mangrove, *A. germinans*, was represented by trees 8 to 10 m tall that form part of the lateral belt bordering the mangrove to the north of the Wildlife Fauna Reservoir. Completely dry individuals

were also recorded, some standing dead and others with only trunk remnants. This was linked to the limited water supply, drought, and high salinity of the surface water (45 and 75 ppm) detected in the area, generating serious consequences such as habitat loss for fauna and a decrease in the input of allochthonous organic matter for the aquatic biota of the swamp.

Meanwhile, *R. mangle* was inventoried in the mangrove forest adjacent to the estuarine waters of Lake Maracaibo and near La Palmita Cove. The mangrove consisted of trees up to 15 m tall, with a fairly uniform, closed canopy, with few gaps or openings due to fallen trees, and the forest could be in advanced and mature succession.

The species *B. humilis* (dwarf bromelia) is a rosette-forming herb that grows in colonies, which are often burned by locals in the ABRAE (Areas Under Special Administration Regime) under study to drive away hidden snakes, thus causing the death and destruction of these populations. Bello Pulido (2018) has reported the uprooting and burning of entire populations of dwarf bromelia to capture red-footed tortoises (*Chelonides carbonaria*) in xerophytic shrublands of Sucre State, Venezuela; in addition to the use of its organic fertilizer, “tierra de caracuey”, and the uncontrolled use of *B. humilis* in the landscaping of gardens, plazas, and roundabouts. It is likely that these uncontrolled and unregulated practices will impact the reproduction, growth, and development of its wild populations in arid and semi-arid zones of the country.

The bromeliad *B. humilis* is endemic to Venezuela and has a restricted distribution within the country (Huérffano *et al.*, 2020). Therefore, it warrants protection, propagation practices in nurseries, and a reduction in its removal from the wild habitat.

The species *E. cordigera* (butterfly orchid) was found only in the deciduous thorny xerophytic shrublands of the southern sector of the reservoir, where few individuals were recorded, Table 1. The main threat to this orchid is its exploitation for ornamental use, sale along roadsides, in urban nurseries, and for export (Huérffano *et al.*, 2020). Leopardi *et al.* (2009) have also reported *E. cordigera* in the xerophytic shrublands of the Araya Peninsula, Sucre State, and due to its Near Threatened status, policies should be declared to contribute to its conservation in arid and semi-arid zones of the country.

According to Huérffano *et al.* (2020), the locations where *E. cordigera* has been reported do not correspond to protected areas, although its presence is likely in some national parks. This assertion is important, given that the presence of *E. cordigera* in wild habitats within the studied ABRAE (Areas Under Special Administration Regime) is unique and warrants preventive measures for its conservation.

The species *Acanthocereus tetragonus* (L.) Hummelinck, *Astronium graveolens* Jacq., *C. erectus*, *Copernicia tectorum* (Kunth) Mart., *Croton hostmannii* Miq., and *Pterocarpus officinalis* Jacq. were grouped in the Least Concern (LC) category, Table 1, which includes taxa that, upon evaluation, do not meet any of the criteria for the Critically Endangered, Endangered, Vulnerable, or Near Threatened categories. Therefore, this category includes abundant species with a wide distribution (Huérffano *et al.*, 2020).

This applies to *A. tetragonus* (barbed-wire cactus), since according to Sánchez-Urdaneta *et al.* (2022) this species occupied the third place of the cacti with the most preserved specimens (127) in the collections of the nine (9) main herbaria of Venezuela.

On the other hand, *C. tectorum* (sará palm) and *C. hostmannii* (croton) were inventoried only on El Hicacal Islet; two individuals of the former and three of the latter were recorded, and both were

located near the ecotone of mangrove forest and deciduous thorny xerophytic shrublands, Table 1.

The limited distribution of these species was associated with their presence in the small xerophytic enclave called El Hicacal Islet, which is isolated or separated from the rest of the xerophytic communities of the Wildlife Fauna Reservoir by the mangrove forest (Vera *et al.*, 2019). This has possibly acted as a physical barrier preventing these species from dispersing, colonizing, and occupying other areas of the reservoir.

Meanwhile, although *A. tetragonus* and *A. graveolens* (glassywood) were recorded in both deciduous thorny xerophytic shrublands, Table 1, the first species was found in areas with moderate anthropogenic intervention, while the second was located in a single area of the shrubland in the southern sector of the reservoir, forming small populations (10° 35' 46.0" N and 71° 30' 09.0" W). *A. graveolens* was also found forming a population of very few trees in an area of the deciduous thorny xerophytic shrubland of El Hicacal Islet.

The species *C. erectus* (buttonwood mangrove) was located in areas such as La Palmita Cove, sand berms, the mangrove forest, and ecotones, subject to flooding from estuarine waters and the swamp. In addition, patches of very low-growing *C. erectus* shrubs, some multi-stemmed and some dead individuals (standing dead), were found along the edges of the swamp. This was linked to the threats facing the area, such as limited water supply (low water flow), drought, and high surface water salinity (45 and 75 ppm).

All of the above should serve to focus attention on this sector of the wildlife fauna reservoir, which is wild habitat to these *C. erectus* populations whose survival is compromised.

Regarding *P. officinalis* (dragonsblood tree), very few individuals were found on the sand berms and in the mangrove forest of the Wildlife Fauna Reservoir, Table 1; which could be explained by the salinities of 5 and 15 ppm recorded in the area. These values could limit a greater abundance of *P. officinalis*, given that it is a non-halophytic plant that reaches its greatest development and survival in non-saline wetlands such as swamps and riparian environments.

Regarding the species *Evolvulus villosissimus* Ooststr., *Ipomoea chenopodiifolia* (M. Martens & Galeotti) Hemsl., and *Terminalia catappa* L., Table 1, were categorized as Data Deficient (DD), a category that includes taxa with limited scientific information for assessing their extinction risk, distribution, and/or population dynamics.

The convolvulaceae *E. villosissimus* (shaggy dwarf morning-glory) was recorded only for El Hicacal Islet and is endemic to Venezuela, Table 1 (Huérffano *et al.*, 2020). This is considered important because, nationally, it has been reported in the states of Anzoátegui, Bolívar, and Monagas, according to Hokche *et al.* (2008) and Lárez *et al.* (2017). Therefore, it is suggested that management measures be included in the Ordinance Plan and Usage Regulation (Plan de Ordenamiento y Reglamento de Uso; PORU) for this Area Under Special Administration Regime (ABRAE).

Very few individuals of the species *I. chenopodiifolia* (morning glory) and *T. catappa* (Indian-almond) were inventoried; the former was located in the shrublands of the southern sector of the reservoir, and only three individuals of the latter were recorded: one on the sand berms near La Palmita Cove and two within the mangrove forest, Table 1.

The species *I. chenopodiifolia* is only reported for the Capital District, Aragua State, and Trujillo State, while *T. catappa* is only

recorded in the Capital District and Mérida State (Hokche *et al.*, 2008). The limited information currently available on these species suggests the need for further scientific understanding of their wild status.

Conclusions

It is concluded that the number of species at risk in the plant communities of the Wildlife Fauna Reservoir Ciénaga de La Palmita and Isla de Pájaros is increasing due to anthropogenic disturbances that currently threaten its flora.

This study contributes to the implementation of scientific research projects and plans on conservation and restoration, in order to counteract the critical situation of the plant communities in this protected natural area.

The scientific knowledge generated regarding the risk faced by some plant species in this ABRAE constitutes baseline information for the formulation of the Ordinance Plan and Usage Regulation (PORU), in order to promote the sustainable management of plant resources in this Wildlife Fauna Reservoir.

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