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ARTICLE

Amphibian Diversity: Where everything starts to flood, Cáceres Municipality, North Pantanal, Central-West Brazil

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Abstract. Faunal inventories contribute to our understanding of regional diversity, and are fundamental for policy and decision-making regarding the management and conservation of large natural areas. This study aimed to inventory and compile information on amphibian species occurring in the North Pantanal region, in the municipal limits of Cáceres, Mato Grosso, Brazil. We used three methods to inventory amphibian species: (1) fieldwork, (2) analysis of specimens deposited in scientific collections, and (3) literature reviews. We registered 49 amphibian species in Cáceres. Of them, 48 species belonged to the Anura order and were distributed across eight families and 20 genera, and one species belonged to the Gymnophiona order (*Siphonops paulensis*). The families Leptodactylidae (20 spp.) and Hylidae (17 spp.) were dominant in terms of richness, accounting for 75.5% of all species found in Cáceres. The remaining families had between four and one species each. The municipality is strongly influenced by non-forested formations (*e.g.,* the Cerrado and Pantanal) and presents a high species richness for a non-forested location in Brazil. Our findings highlight Cáceres as one of the richest areas in amphibian species in the North Pantanal region, expanding our knowledge regarding frog diversity. This study provides a foundation for future conservation strategies and additional assessments of amphibian species in light of potential population declines and other emerging threats.

Keywords. Anuran; Conservation; Transition area; Wetland.

INTRODUCTION

Amphibians face the most significant deficit in conservation studies at global, continental (*e.g.,* South America) and national (*e.g.,* Brazil) levels (Lawler *et al.,* 2006; Campos *et al.,* 2014; Christie *et al.,* 2020). Brazil has the highest amphibian richness in the world, with approximately 1,184 described species (Segalla *et al.,* 2021), and the greatest potential for the discovery of the new amphibian species (Moura & Jetz, 2021). Given its territorial extent and morpho-climatic diversity, expanding the knowledge about amphibian occurrence and conservation in Brazil has become a challenge (Olson *et al.,* 2001).

Some studies seeking to expand our understanding of amphibian occurrence used municipal boundaries to delineate their research areas across various ecoregions (or ecoregion combination). Examples include the Chaco (Souza *et al.,* 2010), Amazonia (Prudente *et al.,* 2013; Azevedo *et al.,* 2021), Amazonia and Cerrado (Silva *et al.,* 2020), Atlantic Forest (Gondim-Silva *et al.,* 2016; Neves *et al.,* 2017; Ferreira *et al.,* 2019; Protázio *et al.,* 2021), Atlantic Forest and Cerrado (Araujo *et al.,* 2013), Cerrado (Santos *et al.,* 2011), Cerrado and Caatinga (Andrade *et al.,* 2014) and Cerrado and Pantanal (Melo *et al.,* 2021). However, none of these studies contemplate the northern part of the Pantanal and the Brazilian Chiquitano.

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Amphibian richness in the Pantanal can range between 30 to 56 species (Souza *et al.,* 2017; Neves *et al.,* 2020; Melo *et al.,* 2021) and many areas within this region remain unexplored or poorly sampled (Neves *et al.,* 2020).

The Pantanal is among the planet's largest wetlands and has been recognized as a UNESCO World Heritage Site since 2000 (UNESCO, 2022). This ecoregion is characterized by annual flood pulses that result in alternating habitats (Prado *et al.,* 1994). The Pantanal is located in central South America (Alho *et al.,* 1988; Harris *et al.,* 2005), contained mostly within Brazil, in the states of Mato Grosso do Sul (southern Pantanal) and Mato Grosso (northern Pantanal) (Alho, 2005). According to Silva & Abdon (1998), Mato Grosso encompasses 35.36% of the Pantanal, which is distributed across seven municipalities: Lambari D'Oeste, Nossa Senhora do Livramento, Itiquira, Santo Antônio do Leverger, Barão de Melgaço, Poconé and Cáceres.

The municipality of Cáceres has a phytophysiognomy characterized by transition areas of: Cerrado, Chiquitano Dry Forest, and Pantanal (Olson *et al.,* 2001). Located in the Northern Pantanal subregion (Silva & Abdon, 1998), Cáceres sits on the banks of the Paraguay River, the main drainage channel of the Pantanal, at the northernmost section of the floodplain (Lázaro *et al.,* 2020). Ranching is Cáceres' main economic activity, complemented by fishing tourism and family farming (Leandro & Rocha, 2019; IBGE, 2022). The Pantanal of Cáceres lost 32.95% of its vegetation between 1993 and 2014, while exotic pasture areas expanded and occupied 33.85% of the region (Aquino *et al.,* 2017). Exotic grass species – easily propagating invaders that compete with native species – have also been introduced in the Pantanal and now threaten the region's natural balance (Guglieri *et al.,* 2009; Nunes da Cunha & Junk, 2019). Pasture management and land clearing for agriculture and livestock are usually carried out using fire (Abreu & Souza, 2016), causing significant biodiversity loss in the Pantanal (Tomas *et al.,* 2021).

Protected Areas (PAs) are often the cornerstone of conservation planning and a safeguard for in situ diversity (Margules & Pressey, 2000; Chen *et al.,* 2017). However, despite the heterogeneity and importance of the Pantanal, only 4.4% of its extension is protected by federal PAs (ICMBio, 2022). Cáceres houses two of these: the Estação Ecológica de Taiamã (EET) (11.555 ha) and part of the Estação Ecológica da Serra das Araras (EESA) (848.27 ha) (UCB, 2021).

This suggests that not all of the ecoregion's environmental diversity is encompassed by PAs, leaving unprotected phytophysiognomies more susceptible to degradation and anthropic action. Landscape homogenization can negatively affect the diversity of anuran amphibians in Northern Pantanal (Dorado-Rodrigues *et al.,* 2015), since changes in plant communities can shape anuran community structure (Bastazini *et al.,* 2007). Due to their dependence on specific environmental conditions and their high physiological sensitivity, amphibians are important bioindicators (Toledo *et al.,* 2010). Their communities are extremely sensitive to ecological stress, which can result in the survival of resilient species and a significant decline of more susceptible ones (Welsh & Ollivier, 1998; Sumanasekara *et al.,* 2015).

The vulnerability of amphibians, combined with escalating environmental changes, leaves them at risk of extinction, with human activity as the primary threat (Eterovick *et al.,* 2005; McCallum, 2007; Andrade, 2015). In this context, faunal inventories contribute to our understanding of regional diversity and are fundamental for conservation management and decision-making in large natural areas (Eterovick *et al.,* 2005; Silveira *et al.,* 2010). Thus, this study aims to inventory and compile information on amphibian species occurring in the region of the Cáceres municipality, North Pantanal, Mato Grosso state, Brazil.

MATERIAL AND METHODS

Study sites

The municipality of Cáceres is located on the border between Brazil and Bolivia, in the state of Mato Grosso (16°05′S, 57°40′W), in the center of South America. It falls within the Upper Paraguay River Basin and the North Pantanal subregion (Fig. 1) (IBGE, 2022). Spanning an area of 24,794.8 km^2, its altitude varies between 90 m m a.s.l. (plain, 17°33′S, 57°35′W) and 900 m a.s.l. (surrounding plateau, 15°54′S 57°14′W). The region's climate is classified as Aw, and features a rainy season from October to April and a dry season from May to September (Alvares *et al.,* 2014). Most of Cáceres' territory lies within the northern part of the Pantanal floodplain (Fig. 1) (Silva & Abdon, 1998).

The hydrological dynamics of the Pantanal of Cáceres are characterized by flooding from November to January, full flood from February to April, ebb from May to July, and drougtht from August to October (Lázaro *et al.,* 2020). This pattern causes periodic overflow of rivers and lakes in the region, regulating ecological processes and making habitats alternate between aquatic and terrestrial states throughout the year (Alho, 2005).

The Cerrado ecoregion has not been extensively studied within the municipality, but it presents a diversity of phytophysiognomies (Moura, 2010). The Chiquitano Dry Forest ecoregion is found both in the far north and far south of Cáceres, and it presents valuable areas for research, as it's restricted to small areas of Brazil, such as southern Mato Grosso and the far west of Mato Grosso do Sul (Olson *et al.,* 2001) (Fig. 1).

Data collection

In the inventory of amphibian species in Cáceres, we employed three sampling methods: (1) fieldwork with *pitfall traps;* (2) analysis of specimens deposited in scientific collections; and (3) a review of literature records. The region selected for fieldwork is densely populated by jaguars (*Panthera onca*) (Kantek & Onuma, 2013; Alvarenga *et al.,* 2021), rendering active search for anurans impossible.

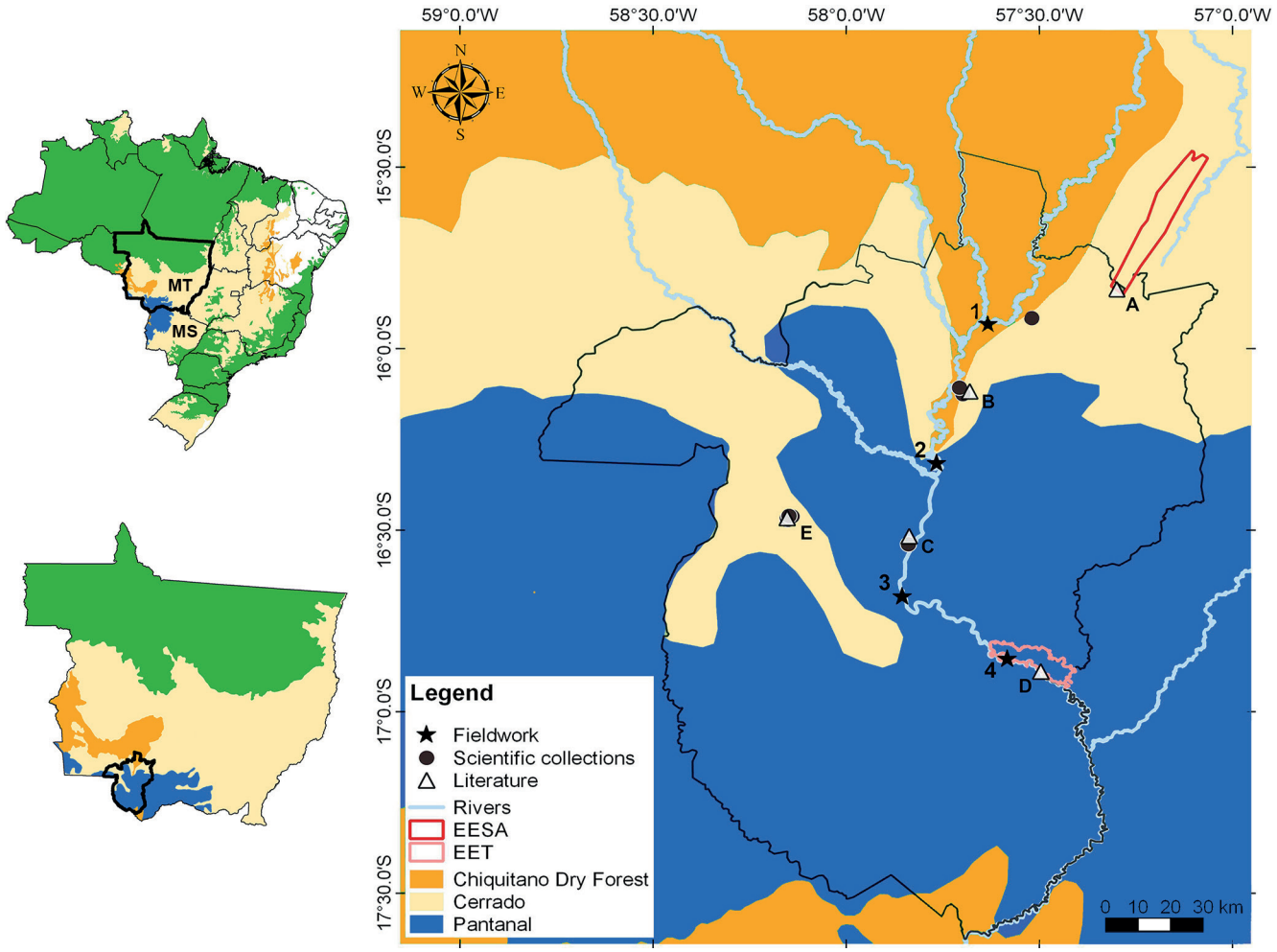

Figure 1. Sampling sites in the municipality of Cáceres, Mato Grosso, Brazil. Abbreviations: MT = Mato Grosso, MS = Mato Grosso do Sul, EESA = Estação Ecológica da Serra das Araras and EET = Estação Ecológica de Taiamã. Fieldwork (stars): 1 = Sepotuba river mouth, 2 = Jauru River mouth, 3 = Morrinhos Farm region and 4 = Estação Ecológica de Taiamã. Literature records (triangles): A = ICMBio (2016), B = Andrade *et al.* (2017), C = Faria & Mott (2011), D = Silva-Alves *et al.* (2020), and E = Pansonato *et al.* (2011).

Fieldwork was carried out from July to November 2017 in the riparian forest, in four different sites along the upper course of the Paraguay River: the Sepotuba River mouth (SR), the Jauru River mouth (JR), the Morrinhos farm region (MF), and Estação Ecológica de Taiamã (EET) (Table 1 and Fig. 1). In each sampled site, four points were selected for the installation of pitfalls traps, totaling 16 points.

We followed three criteria for trap placement: (1) A minimum distance of 35 km between sites (in a straight line), (2) 200 m of dry land distance from the Paraguay River's bank, and (3) The presence of arboreal vegetation. At each sampling point, three sets of traps were installed:

Table 1. Areas sampled in the municipality of Cáceres, Mato Grosso, Brazil. Regions: Sepotuba River mouth (SR), Jauru River mouth (JR), Morrinhos farm region (MF) and Estação Ecológica de Taiamã (EES). Transitions: areas influenced by the Chiquitano Dry Forest, Cerrado and Pantanal.

Region	Ecoregion	Period	Latitude	Longitude
SR	Transition	01-10/07/17	15°56'S	57°38'W
JR	Pantanal	06-16/10/17	16°19'S	57°46'W
MF	Pantanal	09-19/11/17	16°41'S	57°51'W
EET	Pantanal	04-14/08/17	16°51'S	57°35'W

one at 20 m from the riverbank, another at 100 m, and the last at 200 m, into the vegetation patch. The traps were arranged in a 'Y' configuration using four 60 L buckets buried at ground level, separated by 15 m and interconnected by a 70 cm tall canvas guide fence (Cechin & Martins, 2000). This amounted to a total of 192 buckets. The traps remained open for ten consecutive days at each point, with inspections carried out every morning.

Captured specimens were euthanized using a 2% lidocaine hydrochloride injection solution, fixed in 10% formalin, and preserved in 70% alcohol. The specimens were housed in the collection of the Centro de Pesquisa em Limnologia, Biodiversidade e Etnobiologia do Pantanal (CELBE) at the Universidade do Estado de Mato Grosso (UNEMAT) in Cáceres (under collection license SISBIO number #8849-1 and #59443-1, expedition registration number #10128). The euthanasia procedure was approved by the Ethics Committee for the Use of Animals of UNEMAT, under process number 007/2018 CEUA/UNEMAT, opinion 003/2019.

To obtain records of species previously registered in the municipality of Cáceres, we visited three scientific collections: (i) Coleção Zoológica da Universidade Federal de Mato Grosso (ZUFMT-AMP), Cuiabá, Mato

Grosso; (ii) Coleção Herpetológica Célio Haddad, Universidade Estadual Paulista (CFBH), Rio Claro, São Paulo; and (iii) Coleção de Anfíbios do Museu Nacional da Universidade Federal do Rio de Janeiro (MNRJ) in the city of Rio de Janeiro, Rio de Janeiro.

The identification of each specimen was verified by examining their morphology and consulting pertinent literature (*e.g.,* Ávila *et al.,* 2021). We followed the nomenclature guidelines provided by Segalla *et al.* (2021) and Frost (2023). Species were categorized based on their extinction risk as outlined by the IUCN (2022) and the Brazilian Red List (ICMBio, 2018; MMA, 2022). Habit and habitat use of each species were categorized following Neves *et al.* (2020), the records were mapped together with the boundaries of Protected Areas (PA) to identify which species are recorded in existing PAs.

To complement our data set, we searched for additional literature records in the international Web of Science, ScienceDirect, Scielo, and Scopus databases on November 6, 2020. We carried out these searches to find indexed scientific articles reporting the occurrence of amphibians in Cáceres. We used the following search terms: Herpetofauna; Amphibia; Anura; Pantanal; Brazil; Mato Grosso; and Cáceres. The terms could appear in the title, abstract, and/or keywords. We also replicated this search, substituting "Pantanal" with "Cerrado" and "Chiquitano Dry Forest". The terms were employed in several combinations, using the Boolean operators AND/OR, and appending an asterisk on the end of each term to encompass singular, plural, and variant forms. Temporal filters corresponded to the entire available period.

RESULTS

We registered 49 species of amphibians in the municipality of Cáceres (Table 2 and Appendix I). The families Leptodactylidae (20 spp.) and Hylidae (17 spp.) predominated in terms of richness, representing 75.5% of the total species identified in Cáceres, followed by Microhylidae (4 spp.), Bufonidae (3 spp.) and Strabomantidae (2 spp.). Other families were represented by a single species (Table 2). Of the 49 species, belonged to the order Anura, spread across eight families and 20 genera, while only one species belonged to the order Gymnophiona (*Siphonops paulensis*). Literature records accounted for 79% (38 spp.) of these species, listed in five scientific articles reporting amphibian species in Cáceres (Faria & Mott, 2011; Pansonato *et al.,* 2011; Andrade *et al.,* 2017; ICMBio, 2016; Silva-Alves *et al.,* 2020). Scientific collections accounted for 71% (34 spp.) of total richness, with 363 specimens. *Pitfall traps* captured 33% (16 spp.) of the total number of species through a sampling effort of 1,800 buckets/night, collecting 575 specimens. Five of the listed species were recorded exclusively through fieldwork sampling (Table 2 and Fig. 2).

The amphibians found in Cáceres show different neotropical distribution patterns. We recorded species frequently found in the Pantanal ecoregion (*e.g., Lysapsus limellum, Elachistocleis corumbaensis, E. bicolor*), and species typical from the Cerrado (*e.g., Rhinella scitula, Ameerega braccata, Dendropsophus elianeae, Pristimantis dundeei, Pseudopaludicola ameghini, P. saltica, Oreobates heterodactylus*), Cerrado/Atlantic Forest (*e.g., Leptodactylus mystacinus*), Chaco (*e.g., Leptodactylus bufonius*), and Amazonia (*e.g., Osteocephalus taurinus, Scinax nebulosus*) regions.

Eighteen amphibian species were only found in the floodplain region encompassing the Pantanal of Cáceres; eight were restricted to the surrounding plateau (Cerrado and Chiquitano Dry Forest), and 24 were present in both regions (Table 1). A few species (n = 5) were restricted to forest areas, and 17 used both open and forest environments. The majority (28 spp.) were registered in open landscapes (Table 2). Regarding habitat use, 92% of the registered species use aquatic habitats, with 63% using terrestrial, 31% arboreal and 24% fossorial habitats (Table 2). Only two species were strictly aquatic (*L. limellum* and *Pseudis platensis*) and two strictly terrestrial (*O. heterodactylus* and *P. dundeei*).

None of the 49 species of amphibians registered in Cáceres are currently listed as facing an extinction threat (ICMBio, 2018; IUCN, 2022; MMA, 2022). Amphibian records from Protected Areas in Cáceres (EESA and EET) encompass 55% of the total species. Regarding the extinction risk of species, *E. corumbaensis* in the EET (Fig. 2E) lacked sufficient data for assessment, and *R. diptycha* (Fig. 2J-K) (EET/EESA), *R. scitula* (Fig. 2L) (EET), and *P. dundeei* (EESA) were categorized as "Deficient Data" using the IUCN guidelines (2022).

Among the species recorded in the municipality of Cáceres, we extended the recognized geographic distribution of *O. heterodactylus* to approximately 80 km south of its type locality, and confirmed the occurrence of *L. bufonius,* previously recorded in Cáceres, but not considered a local species in later publications (Fig. 3).

DISCUSSION

Regional amphibian diversity

In Mato Grosso state, amphibian local richness (171 spp. in total) tended to track morphoclimatic characteristics of different regions (Ávila *et al.,* 2021). Transition areas influenced by the Amazon and Cerrado ecosystems contained between 30 and 53 species (= 43) (São-Pedro *et al.,* 2009; Ávila & Kawashita-Ribeiro, 2011; Noronha *et al.,* 2015; Rodrigues *et al.,* 2015). In region dominated solely by the Cerrado, richness tends to be lower between 16 and 45 species (= 31) (Strüssmann, 2000; Mendes-Pinto & Miranda, 2011; Santos *et al.,* 2011; Bitar *et al.,* 2012; Campos *et al.,* 2013; Silva *et al.,* 2015; ICMBio, 2016). Average richness is even lower in areas where the phytophysiognomy of the Cerrado and Pantanal combine (= 27), ranging 21 to 34 (Silva Jr. *et al.,* 2009; Pansonato *et al.,* 2011; Dorado-Rodrigues *et al.,* 2015; Valério *et al.,* 2016).

Cáceres is strongly influenced by non-forested landscapes (Cerrado and Pantanal) and is remarkably diverse,

housing 30% of the amphibian species of Mato Grosso and also 43% (49 spp.) of the 113 amphibian species (Neves *et al.,* 2020) known in the Upper Paraguay River Basin. As has been observed for other groups, such as birds (Lopes *et al.,* 2016), Cáceres harbors substantial richness for a non-forested region in Brazil.

Considering Pantanal subregions of Mato Grosso, defined by Silva & Abdon (1998), the "Pantanal of Poconé" houses approximately 32 amphibian species (Valério-Brun *et al.,* 2010; Dorado-Rodrigues *et al.,* 2015; Valério *et al.,* 2016), while the "Pantanal of Cáceres" has a higher richness, with 42 species. Fauna compilations encompassing the Brazilian floodplain report numbers ranging from 45 to 56 amphibian species (Strüssmann *et al.,* 2011; Souza *et al.,* 2017; Melo *et al.,* 2021).

However, even with the Pantanal covering most of the municipality, approximately 21% of the species registered in Cáceres are more closely associated with the Cerrado, an ecosystem also known as the tropical savanna (Valdujo *et al.,* 2012). This is a threatened ecoregion, with approximately half of its total area converted primarily for agriculture and cattle ranching (Mittermeier *et al.,* 2004; Lima *et al.,* 2020). No recorded species are associated with the Chiquitano Dry Forest, and this ecoregion is only modestly represented in terms of amphibian richness in the Pantanal and the surrounding plateau (Neves *et al.,* 2020).

Leptodactylidae and Hylidae are families with the most species record in Cáceres. This is probably due to the great diversity of species within these families in Brazil (Segalla *et al.,* 2021) and in the state of Mato Grosso (Ávila *et al.,* 2021). The same pattern has been observed in studies from the northern region of the Pantanal (Pansonato *et al.,* 2011; Dorado-Rodrigues *et al.,* 2015; Valério *et al.,* 2016).

Figure 2. Some of the anurans registered in the fieldwork, municipality of Cáceres, Mato Grosso, Brazil. A = *Adenomera* cf. *diptyx,* B = *Dermatonotus muelleri,* C = *D. muelleri* in amplexus, D = *Elachistocleis bicolor*, E = *E. corumbaensis,* F = *Leptodactylus* cf. *brevipes*, G = *L. elenae,* H = *L. podicipinus,* I = *Oreobates heterodactylus,* J = *Rhinella diptycha*, K = *R. diptycha* young and L = *R. scitula.* (Photo by D.J. Silva).

Although no species is currently classified as under any level of threat according to the IUCN (2022) and the MMA (2022), five species fall under the "Data Deficient" (DD) category, and five were never assessed using the IUCN guidelines (2022) (Appendix I). According to the Brazilian Red List, *Elachistocleis corumbaensis, Leptodactylus* cf. *brevipes* and *Pseudopaludicola motorzinho* were not yet assessed, and *P. ameghini* is categorized as (DD) (ICMBio, 2018). Species categorized as DD warrant special attention, as this category can mask the actual threat level they face, leaving them unprotected by legislation (Marques *et al.*, 2005; Haddad, 2008). In Cáceres, federally Protected Areas have been characterized as important sites for amphibian diversity, as they account for 55% (27 spp.) of total species richness.

Geographic distribution updates

The distribution of *Oreobates heterodactylus* was recently reassessed (see Pansonato *et al.*, 2020), with its type locality defined as Gruta Fazendinha, in the municipality of Cáceres. We recorded *O. heterodactylus* (Fig. 2I) in the Morrinhos farm (Table 1), approximately 80 km south of its type locality, in the edge of the mountainous province "Grupo Alto Paraguai", bordering the floodplain (Ross, 1991). It represents the southernmost record for the species and the closest to the Pantanal floodplain, situated within a semideciduous riparian forest environment featuring rocky outcrops.

Leptodactylus bufonius, a species typical of the Chaco ecoregion (Brusquetti *et al.*, 2019), was registered by Pansonato *et al.* (2011) in Cáceres, currently the

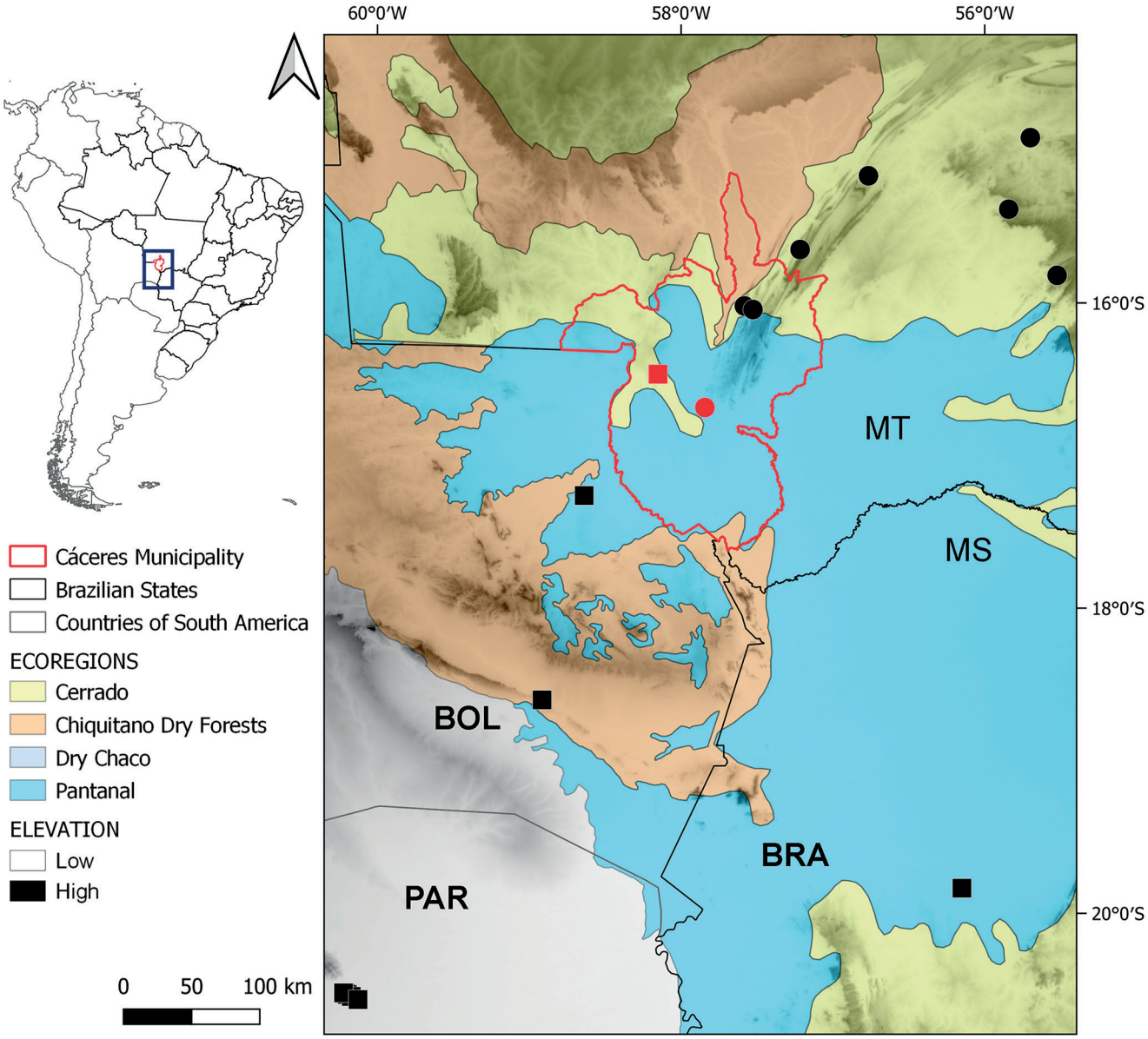

Figure 3. Geographic distribution map of *Oreobates heterodactylus* (circles), and *Leptodactylus bufonius* (squares) in the region of Cáceres (highlighted by a blue frame on the South America map), Mato Grosso, Brazil. References: Black circles (Pansonato *et al.*, 2020), red circle (fieldwork – this study), black squares (Neves *et al.*, 2020), and red square (Pansonato *et al.*, 2011). Abbreviations: BOL = Bolivia, PAR = Paraguai, BRA = Brazil, MT = Mato Grosso State, and MS = Mato Grosso do Sul State. Background elevation ranges from 0 to 1,000 meters.

Table 2. Amphibian species recorded in the municipality of Cáceres, Mato Grosso state, Brazil. Habitats: open formation (OF), riparian forest (RF) and fragment forest (FF). Habitat use: Aquatic (aq), Arboreal (ar), Fossorial (fo) and Terrestrial (te). PAs (Protected Areas): EET = Estação Ecológica de Taiamã and EESA = Estação Ecológica da Serra das Araras. References: Fieldwork (F), Scientific collections (SC) and literature: Faria & Mott (2011) (L1), Pansonato *et al.* (2011) (L2), Andrade *et al.* (2017) (L3), ICMBio (2016) (L4), and Silva-Alves *et al.* (2020) (L5).

ORDER/Family/Species	Habitat (Habitat use)	PAs	Macroregion	References
ANURA				
Bufonidae				
Rhinella major (Müller & Hellmich, 1936)	OF (aq, te)	—	Plateau/Plain	SC/L2
Rhinella scitula (Caramaschi & Niemeyer, 2003)	FF, OF, RF (aq, te)	EET	Plain	F
Rhinella diptycha (Cope, 1862)	OF, RF (aq, te)	EET/EESA	Plateau/Plain	F/L2/L4
Dendrobatidae				
Ameerega braccata (Steindachner, 1864)	FF (aq, te)	EESA	Plateau	L4
Hylidae				
Boana albopunctata (Spix, 1824)	OF (aq, ar)	EESA	Plateau	L4
Boana geographica (Spix, 1824)	OF, RF (aq, ar, te)	—	Plain	F
Boana punctata (Schneider, 1799)	OF (aq, ar)	EESA	Plateau/Plain	SC
Boana raniceps (Cope, 1862)	OF (aq, ar)	EET/EESA	Plateau/Plain	SC/L2/L4
Dendropsophus elianeae (Napoli & Caramaschi, 2000)	OF (aq, ar)	—	Plain	SC
Dendropsophus melanargyreus (Cope, 1887)	OF (aq, ar)	EESA	Plateau/Plain	SC/L2/L4
Dendropsophus minutus (Peters, 1872)	OF (aq, ar)	EESA	Plateau/Plain	SC/L2/L4
Dendropsophus nanus (Boulenger, 1889)	OF (aq, ar)	EESA	Plateau/Plain	SC/L2/L4
Lysapsus limellum Cope, 1862	OF (aq)	—	Plateau/Plain	SC/L2
Osteocephalus taurinus Steindachner, 1862	FF (aq, ar)	EESA	Plateau	L4
Pseudis platensis Gallardo, 1961	OF (aq)	—	Plateau/Plain	SC/L2
Scinax acuminatus (Cope, 1862)	OF (aq, ar)	—	Plain	SC/L2
Scinax fuscomarginatus (Lutz, 1925)	OF (aq, ar)	—	Plateau/Plain	SC/L2
Scinax fuscovarius (Lutz, 1925)	OF (aq, ar)	EESA	Plateau/Plain	SC/L2/L4
Scinax nasicus (Cope, 1862)	OF (aq, ar)	—	Plain	SC/L2
Scinax nebulosus (Spix, 1824)	OF (aq, ar)	—	Plateau/Plain	SC
Trachycephalus typhonius (Linnaeus, 1758)	OF (aq, ar)	EESA	Plateau/Plain	SC/L2/L4
Leptodactylidae				
Adenomera cf. *diptyx* (Boettger, 1885)	OF, RF (fo, te)	—	Plain	SC/F
Leptodactylus bufonius Boulenger, 1894	OF (aq, fo, te)	—	Plain	L2
Leptodactylus macrosternum Miranda-Ribeiro, 1926	OF (aq, te)	EESA	Plateau/Plain	SC/F/L2/L4
Leptodactylus elenae Heyer, 1978	OF, RF (aq, fo, te)	—	Plateau/Plain	SC/F/L2
Leptodactylus fuscus (Schneider, 1799)	OF (aq, fo, te)	EESA	Plateau/Plain	SC/L2/L4
Leptodactylus labyrinthicus (Spix, 1824)	FF, OF, RF (aq, te)	—	Plateau/Plain	SC/L2/L4
Leptodactylus luctator (Hudson, 1892)	OF (aq, te)	EET	Plain	L5
Leptodactylus mystacinus (Burmeister, 1861)	FF, OF (aq, fo, te)	EESA	Plateau/Plain	SC/L2/L4
Leptodactylus podicipinus (Cope, 1862)	OF, RF (aq, te)	EET	Plateau/Plain	SC/F/L2
Leptodactylus cf. *brevipes* Cope, 1887	RF (aq, te)	EET	Plain	F
Leptodactylus syphax Bokermann, 1969	FF, OF (aq, te)	EESA	Plateau	L4
Physalaemus albonotatus (Steindachner, 1864)	OF, RF (aq, te)	EET	Plateau/Plain	SC/F/L2/L4
Physalaemus biligonigerus (Cope, 1861)	OF (aq, te)	—	Plain	SC/L2
Physalaemus centralis Bokermann, 1962	OF (aq, te)	—	Plain	SC/L2
Physalaemus cuvieri Fitzinger, 1826	OF (aq, te)	EESA	Plateau	L4
Physalaemus nattereri (Steindachner, 1863)	OF (aq, te)	EESA	Plateau/Plain	SC/L2/L4
Pseudopaludicola ameghini (Cope, 1887)	OF (aq)	—	Plain	L3
Pseudopaludicola motorzinho Pansonato, Veiga-Menoncello, Mudrek, Jansen, Recco-Pimentel, Martins & Strüssmann, 2016	OF, RF (aq, te)	—	Plain	SC/F
Pseudopaludicola mystacalis (Cope, 1887)	OF, RF (aq, te)	—	Plain	SC/F
Pseudopaludicola saltica (Cope, 1887)	OF (aq, te)	EESA	Plateau	L4
Microhylidae				
Chiasmocleis albopunctata (Boettger, 1885)	FF, OF, RF (aq, fo, te)	EESA	Plateau/Plain	SC/F/L2/L4
Dermatonotus muelleri (Boettger, 1885)	FF, OF (aq, fo, te)	—	Plateau/Plain	SC/F/L2
Elachistocleis bicolor (Guérin-Méneville, 1838)	OF, RF (aq, fo, te)	EET	Plain	SC/F/L2
Elachistocleis corumbaensis Piva, Caramaschi & Albuquerque, 2017	OF, RF (aq, fo, te)	EET	Plain	F
Phyllomedusidae				
Pithecopus azureus (Cope, 1862)	OF (aq, ar)	—	Plateau/Plain	SC/L2
Strabomantidae				
Oreobates heterodactylus (Miranda-Ribeiro, 1937)	FF, RF (te)	—	Plateau	F
Pristimantis dundeei (Heyer & Muñoz, 1999)	FF (ar, te)	EESA	Plateau	L4
GYMNOPHIONA				
Syphonopidae				
Siphonops paulensis Boettger, 1892	OF (fo, te)	—	Plain	L1

northernmost record of its distribution. However, this record was not considered in subsequent publications (Zamudio *et al.,* 2014; Sanabria *et al.,* 2015; Faggioni *et al.,* 2017; Brusquetti *et al.,* 2019). The photographic record of this specimen from Cáceres was mentioned by Schalk & Leavitt (2017), who also omitted this location when presenting a species distribution map. Sá *et al.* (2014) reported the occurrence of *L. bufonius* in Mato Grosso, when comparing its geographic distribution with a similar species (*L. troglodytes*), but their distribution map actually indicates a location in Mato Grosso do Sul. Thus, the current distribution of *L. bufonius* spans the east and southeast of Bolivia, northern Argentina, Paraguay, Brazil (in Mato Grosso do Sul) (Frost, 2023), and Cáceres (in Mato Grosso) (Pansonato, 2011; Ávila *et al.,* 2021). The influence of the Chaco in Cáceres was demonstrated by Lopes *et al.* (2016), who registered birds typical of this ecoregion.

CONCLUSION

Cáceres is situated in a transitional environment characterized by diverse phytophysiognomies. This heterogeneity of habitats is favorable to the occurrence of a diverse amphibian community, with different species distribution patterns from different ecoregions. Our findings highlight Cáceres as one of the richest places in amphibian species in the Pantanal region, and expands our knowledge about anurans. We encourage new inventories and long-term studies, especially in under-sampled areas throughout the Upper Paraguay River Basin (Neves *et al.,* 2020). The dataset compiled for this study provides an information base which can be used in PA management plans, in order to safeguard the biodiversity of the municipality of Cáceres and the surrounding region over the long run.

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APPENDIX I

List of voucher specimens from the municipality of Cáceres, Mato Grosso, Brazil. Abbreviations: IUCN (International Union for Conservation of Nature and Natural Resources): DD = Deficient Data, LC = Least Concern and NE = Not Evaluated. Scientific Collections: UFMT = Coleção Zoológica, Universidade Federal de Mato Grosso; CFBH = Coleção Herpetológica Célio Haddad, Universidade Estadual Paulista; UNEMAT-CH = Coleção Herpetológica, Universidade do Estado de Mato Grosso; AAG-UFU = Coleção de Anuros do Museu de Biodiversidade do Cerrado, Universidade Federal de Uberlândia.

Species	IUCN	Brazilian red list	Voucher
Adenomera diptyx	LC	LC	(UNEMAT-CH A0013, 23, 25, 49, 83, 319, 383, 422), (UFMT 10334, 10347, 10345)
Ameerega braccata	LC	LC	(CFBH 34998)
Boana albopunctata	LC	LC	(UFMT 374)
Boana geographica	LC	LC	(UNEMAT-CH A0160, 161, 181-34, 191)
Boana punctata	LC	LC	(UFMT 1092)
Boana raniceps	LC	LC	(CFBH 21621) (UFMT 1053-55, 10254-62)
Chiasmocleis albopunctata	LC	LC	(UNEMAT-CH A0491) (UFMT 10398)
Dendropsophus elianeae	LC	LC	(UFMT 10277-80)
Dendropsophus melanargyreus	LC	LC	(CFBH 752, 35484-85) (UFMT 10281-85, 714-17)
Dendropsophus minutus	LC	LC	(UFMT 1057-59, 10268-75)
Dendropsophus nanus	LC	LC	(UFMT 1060-64, 1339, 10297-315)
Dermatonotus muelleri	LC	LC	(UNEMAT-CH A0245-55, 261-63, 266-69) (UFMT 1039, 1079, 10209-20) (MNRJ 34130-32)
Elachistocleis bicolor	LC	LC	(UNEMAT-CH A071, 63, 209, 256-60, 264-65) (UFMT 10407, 10411-18)
Elachistocleis corumbaensis	NE	NE	(UNEMAT-CH A0002, 61, 66, 72)
Leptodactylus bufonius	LC	LC	(UFMT 10540)
Leptodactylus macrosternum	LC	LC	(UNEMAT-CH A0003-4, 19, 37-39, 58, 306, 324, 331, 334, 375, 421) (UFMT 1087, 10438-44)
Leptodactylus elenae	LC	LC	(UNEMAT-CH A0027, 56, 222-23, 243-44, 289, 299, 309-10, 316, 333, 368, 417-20) (UFMT 1341, 10316-25, 10327-30)
Leptodactylus fuscus	LC	LC	(UFMT 1098-99, 1342, 10331-33, 10335-44, 103346)
Leptodactylus labyrinthicus	LC	LC	(UFMT 1366, 10432-33)
Leptodactylus luctator	LC	LC	(UNEMAT-CH A0080)
Leptodactylus mystacinus	LC	LC	(UFMT 10437-38)
Leptodactylus podicipinus	LC	LC	(UNEMAT-CH A0005-9, 15-18, 22, 28-34, 40-48, 60, 62, 65, 78, 84-85, 157, 166, 205, 207, 220-21, 224-26, 231-36, 239-51, 270-78, 284-88, 290-91, 298, 307, 313, 315, 317, 321, 323, 325, 327, 329, 335, 344, 346, 350-59, 369-74, 377-82, 389-407, 408-416, 605, 608) (UFMT 1088, 1085-97) (CFBH 28622-26)
Leptodactylus cf. *brevipes*	NE	NE	(UNEMAT-CH A0073)
Leptodactylus syphax	LC	LC	(UFMT 10615)
Lysapsus limellum	LC	LC	(UFMT 1094, 2185, 10371-83)
Oreobates heterodactylus	DD	LC	(UNEMAT-CH A0230, 308, 322, 326, 328, 330, 337, 339)
Osteocephalus taurinus	LC	LC	(UFMT 13849)
Physalaemus albonotatus	LC	LC	(UNEMAT-CH A0219, 305, 312, 314, 320, 332) (UFMT 6645, 10364-70, 10510, 10555, 10570-71, 10574)
Physalaemus biligonigerus	LC	LC	(UFMT 6646, 10351, 10356-63)
Physalaemus centralis	LC	LC	(UFMT 10354-55)
Physalaemus cuvieri	LC	LC	(UFMT 10624)
Physalaemus nattereri	LC	LC	(UFMT 10348-50, 10352-53)
Pithecopus azureus	LC	LC	(UFMT 718, 1091, 10245-53)
Pristimantis dundeei	DD	LC	(UFMT 10626)
Pseudis platensis	DD	LC	(UFMT 1046-52, 10384)
Pseudopaludicola ameghini	NE	DD	(AAG-UFU 5367)
Pseudopaludicola motorzinho	NE	NE	(UNEMAT-CH A0012, A0052)
Pseudopaludicola mystacalis	LC	LC	(UNEMAT-CH A0011, A0024, A0051) (UFMT 10445-60, 10462-75, 10477-10509)
Pseudopaludicola saltica	LC	LC	(UFMT 10637)
Rhinella diptycha	DD	LC	(UNEMAT-CH A0001, 54, 67, 74-77, 86, 156, 158, 162-63, 167, 169, 173, 179-80, 185, 188-90, 200, 202-04, 208, 210-18, 253, 279-83, 292-97, 300-04, 311, 318, 336, 338, 340, 345, 347-48, 376, 387-88, 423, 607) (UFMT 1025, 1343, 1365, 10422-23, 36536-37)
Rhinella major	NE	LC	(UFMT 704, 1086, 10424-31)
Rhinella scitula	DD	LC	(UNEMAT-CH A0014, 20, 21, 26, 35-36, 50, 55, 57, 159, 164-65, 168, 170-72, 174-78, 192-99, 201, 206, 227-29, 237-38, 252, 341-43, 360-67, 385-86, 424-25, 602-04)
Scinax acuminatus	LC	LC	(UFMT 10229-30)
Scinax fuscomarginatus	LC	LC	(UFMT 1065-73, 10233-36, 10240-44)
Scinax fuscovarius	LC	LC	(UFMT 1040, 10221-22, 10224, 10231)
Scinax nasicus	LC	LC	(UFMT 10223, 10225-28, 10232, 10237-39)
Scinax nebulosus	LC	LC	(UFMT 1018-19, 1081-82, 1089)
Siphonops paulensis	LC	LC	(UFMT 6825)
Trachycephalus typhonius	LC	LC	(UFMT 10263-76, 10276)

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