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Mammals in the Cerrado of Northern Minas Gerais

MEDIUM AND LARGE-SIZED MAMMALS FROM THE CERRADO OF THE MUNICIPALITIES OF BURITIZEIRO AND PIRAPORA, MINAS GERAIS, BRAZIL

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Abstract: The Cerrado stands out among the Brazilian biomes due to its vast area and remarkable biological richness. It is also recognized as one of the world's biodiversity hotspots, supporting at least 354 species of mammals, of which 42 are endemic. The municipalities of Pirapora and Buritizeiro, located in the state of Minas Gerais, lie within the Cerrado biome and are recognized as important industrial hubs. Despite their socioeconomic relevance, the region still has gaps in scientific knowledge regarding mammal diversity and distribution. The present study aims to contribute to reducing these gaps using non-invasive sampling methods. To assess the richness of these species, we employed indirect observation techniques combined with camera trapping. A

total of 23 species of medium- and large-sized mammals were recorded in nine orders and 16 families. Among the recorded taxa, two species are endemic to the Cerrado, six are classified under some level of threat, and 11 are known game species. These findings highlight the ecological importance of the region for the conservation of mammalian fauna. The results revealed similarities with mammal communities reported in other Cerrado areas, suggesting connectivity and comparable habitat conditions. Overall, these findings reinforce the importance of faunal surveys in expanding knowledge about mammalian diversity and emphasize their role in supporting conservation strategies, biodiversity assessments, and environmental management actions.

Keywords: biodiversity hotspot; camera trap; Cerrado; endemism; inventory.

INTRODUCTION

The Cerrado is considered a biodiversity hotspot, with high levels of endemism and endangered species, being a conservation priority area, bordering yet another biodiversity hotspot, the Atlantic Forest, as well as the Amazon Basin, which is classified as a Major Tropical Wilderness Area (Mittermeier *et al.* 1998, Myers *et al.* 2000). The Cerrado is particularly prone to the impacts that originate from human activity, mainly deforestation of the natural vegetation coverage due to high agricultural activity (Castilho & Chaveiro 2010, Rosa 2021), granting it the status of a new agricultural frontier (Aguiar & Camargo 2004, Rosa 2021).

Estimates point out that the Cerrado is home to at least 354 species of terrestrial mammals, of which 42 are considered endemic (Vieira-Alencar *et al.* 2025). However, medium and large-sized mammals (> 1 kg) (Emmons & Feer 1997, Chiarello 2000a) make up a small portion of this diversity, with 52 species (Paglia *et al.* 2012). A considerable number of these are endangered, according to the national list of endangered species of Brazil (ICMBio 2026) and the IUCN (IUCN 2026).

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Mammals are associated with several ecosystem processes that contribute to the maintenance of biological diversity and habitat structure. In tropical ecosystems, medium- and large-sized mammals play an important role in maintaining the integrity of natural systems, influencing processes such as seed dispersal, predation, and trophic chain regulation (Terborgh 1988, 1992, Janson & Emmons 1990).

In the transitional region between the upper and middle São Francisco River, near the municipalities of Pirapora and Buritizeiro in the state of Minas Gerais, Brazil, the mammalian fauna is predominantly composed of species typical of the Cerrado domain. Despite the historical and economic importance of this region to the state since the late nineteenth century, partly associated with its role as a river port and railway terminal (Ferreira 2008a), knowledge of mammalian fauna in Cerrado remnants remains limited due to the scarcity of published studies. Moreover, most research conducted in the Cerrado of Minas Gerais has been concentrated in protected areas, while remnant areas outside these spaces remain poorly investigated (Freitas *et al.* 2022). This knowledge gap becomes even more relevant considering that part of the Buritizeiro and Pirapora region has been recognized as a priority area for mammal conservation in Minas Gerais (Drummond *et al.* 2005).

Herein, we present the results of an inventory aimed at characterizing the medium- and large-sized mammals that occur within the municipalities of Buritizeiro and Pirapora. Furthermore, this study aims to reduce the knowledge gap regarding the local mammal community in the Cerrado region outside protected areas (Rosa 2021).

MATERIAL AND METHODS

Study area

Sampling was conducted within the municipalities of Pirapora and Buritizeiro in the northern mesoregion of Minas Gerais state, Brazil, encompassing the upper middle basin of the

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São Francisco River (Viana 2006). Vegetational coverage in the region is composed of different phytophysiognomies of the Cerrado, predominantly "Cerrado Típico" and "Cerradão" (Santos 2015). The climate is a rainy tropical savannah (Aw) considering the Köpen classification (Sá-Jr 2009). The study area corresponds to a fragmented portion of the Brazilian Cerrado (Figure 1), with a central point at 17º21'30.40"S, 44º58'30.83"W, datum SIRGAS 2000. The region can be classified as an industrial hub, characterized by a matrix of areas heavily modified by human activities, including the urban areas of the analyzed municipalities, as well as a strong presence of agricultural activities and remnants of native Cerrado vegetation at different successional stages (Domingues *et al.* 2014).

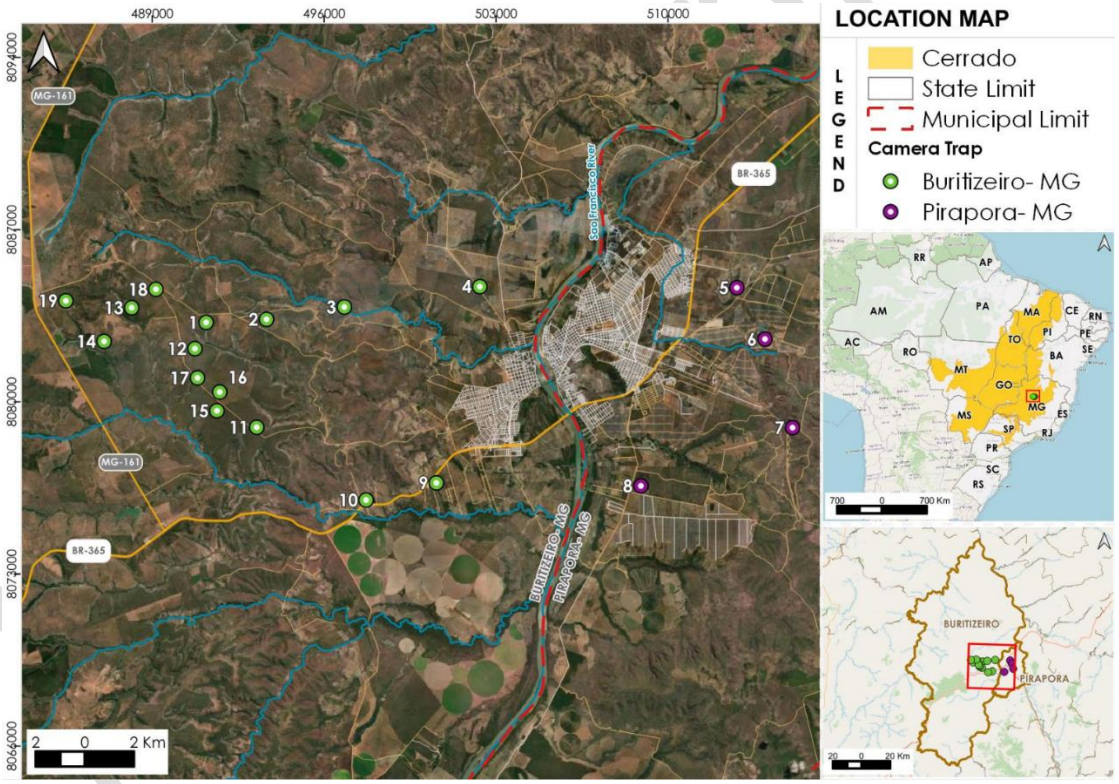

Figure 1. Location of the study site f the medium and large-sized mammal inventory in the municipalities of Pirapora and Buritizeiro, state of Minas Gerais, Brazil.

Sampling of medium and large-sized mammals

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Mammal sampling was conducted during four field campaigns carried out in March, May, and August 2022, and in March 2023. Each campaign lasted five days, except for the second, which lasted six days, totaling 21 sampling days. Active searches were conducted during both daytime and nighttime by two observers throughout all days of each campaign, with a daily effort of six hours. Pre-existing trails and dirt roads were surveyed, located in the same areas where the camera traps were installed, as these sites present a higher potential for observing different species, particularly near water bodies, as highlighted by Pardini *et al.* (2003) and Pereira *et al.* (2012). During the surveys, indirect evidence such as footprints, feces, dens, and vocalizations was recorded, allowing the identification of mammal species occurring in the area. All traces found were identified using specialized field guides, such as Pereira *et al.* (2012) and Becker & Dalponte (2013). In addition, a GPS receiver was used to record the exact location of each occurrence. Active search effort was calculated using the formula (number of active search hours × number of sampling days), totaling 126 hours.

Additionally, 19 Bushnell 16MP E3 camera traps were installed and distributed to cover all sampling days. The cameras were installed approximately 40 cm above the ground and remained active 24 hours per day throughout the entire sampling period of each campaign, with a mean distance between devices of 2.39 km (standard deviation = 1.53 km). Baits composed of fruits, bacon, and salt were used following Santos (2013), and the devices were configured with five-minute intervals between detections, triggered by heat and motion sensors, recording both photographs and videos. During the daytime, images were recorded in color, according to light availability. At night, in the absence of natural light, records were obtained using infrared sensors, resulting in black-and-white images, as described by Tobler *et al.* (2008) and Glen *et al.* (2013).

The camera trap sampling effort was distributed across four field campaigns conducted in three distinct camera deployment areas located in the municipalities of Buritizeiro and Pirapora, Minas Gerais, Brazil. The first and second campaigns were conducted in the same sampling area

(Area 1), located in the municipality of Buritizeiro, with eight camera traps installed in each campaign. The third campaign was carried out in a second sampling area (Area 2), with six cameras equally distributed between the municipalities of Buritizeiro (n = 3) and Pirapora (n = 3). The fourth campaign took place in a third sampling area (Area 3), with five cameras installed, four in Buritizeiro and one in Pirapora. The sampling effort was calculated by multiplying the number of cameras by the number of sampling days in each campaign, considering that all devices remained active throughout the entire sampling period. The first campaign, lasting five days, totaled 40 camera-days, while the second campaign, lasting six days, resulted in 48 camera-days. The third campaign, with six cameras operating for five days, resulted in a sampling effort of 30 camera-days, and the fourth campaign totaled 25 camera-days. Considering the sampling effort by municipality, Buritizeiro concentrated the highest effort, totaling 123 camera-days, while Pirapora accounted for 20 camera-days. Overall, the total camera trap sampling effort of the study reached 143 camera-days.

We followed the nomenclature of the Brazilian Society of Mastozoology (Abreu-Jr *et al.* 2024). To evaluate the threat level of species, we used the "Deliberação Normativa Copam n° 147, de 30 de abril de 2010" (COPAM 2010) for the state of Minas Gerais, the SALVE ICMBio platform (2026) for Brazil, and the IUCN Red List for the global scale (IUCN 2026). Data on the endemism of species followed those of the Gutiérrez & Marinho-Filho (2017) and SALVE ICMBio platform (ICMBio 2026). Furthermore, species status of international trade risk followed the criteria established by CITES (UNEP-WCMC 2025).

Statistical analysis

Records obtained through active searches and camera traps were considered in the analyses adopting spatial and temporal independence criteria to avoid pseudoreplication. For records derived from active searches, considering as independent only those records separated by a

minimum distance of 500 m within each sampling day. For camera trap data, only one record per sampling point per day was considered to ensure the temporal independence of records. Additionally, when coincidences in date and time occurred between records obtained by both methods, only a single record was considered to avoid overestimating the occurrences of the species.

Two cumulative species richness curves were made considering the records obtained using both methods through the EstimateS 9.1.0 software (Colwell 2013), the first curve represented the observed cumulative results, and the second curve represented the Jackknife 1 estimator, indicating potential richness considering field effort and the acquired results. The Jackknife 1 estimator performed 1000 simulations, using field days as sampling units, following Colwell & Coddington (1994). Additionally, the Shannon-Weaver (H) index was used to assess species diversity, and the Pielou index was used to assess equitability (Magurran 2004, 2011). Furthermore, a cluster analysis using Unweighted Paired Group Method (UPGMA) with the Jaccard similarity coefficient was conducted to investigate similarities between data from other studies conducted in the São Francisco River basin and primary acquired data (Fonseca & Silva 2019; Arimoro *et al.* 2020; Pereira *et al.* 2020). These analyses were conducted using the PAST software (Hammer *et al.* 2001).

RESULTS

A total of 23 species of medium- and large-sized terrestrial mammals were recorded for the study area, distributed across nine orders and 16 families (Figure 2). *Cabassous squamicaudis* (Cingulata; Chlamyphoridae) was the most frequently detected taxon, with 28 records (14.7%), followed by *Didelphis albiventris* (Didelphimorphia; Didelphidae) and *Subulo gouazoubira* (Artiodactyla; Cervidae), both with 27 records (14.2%).

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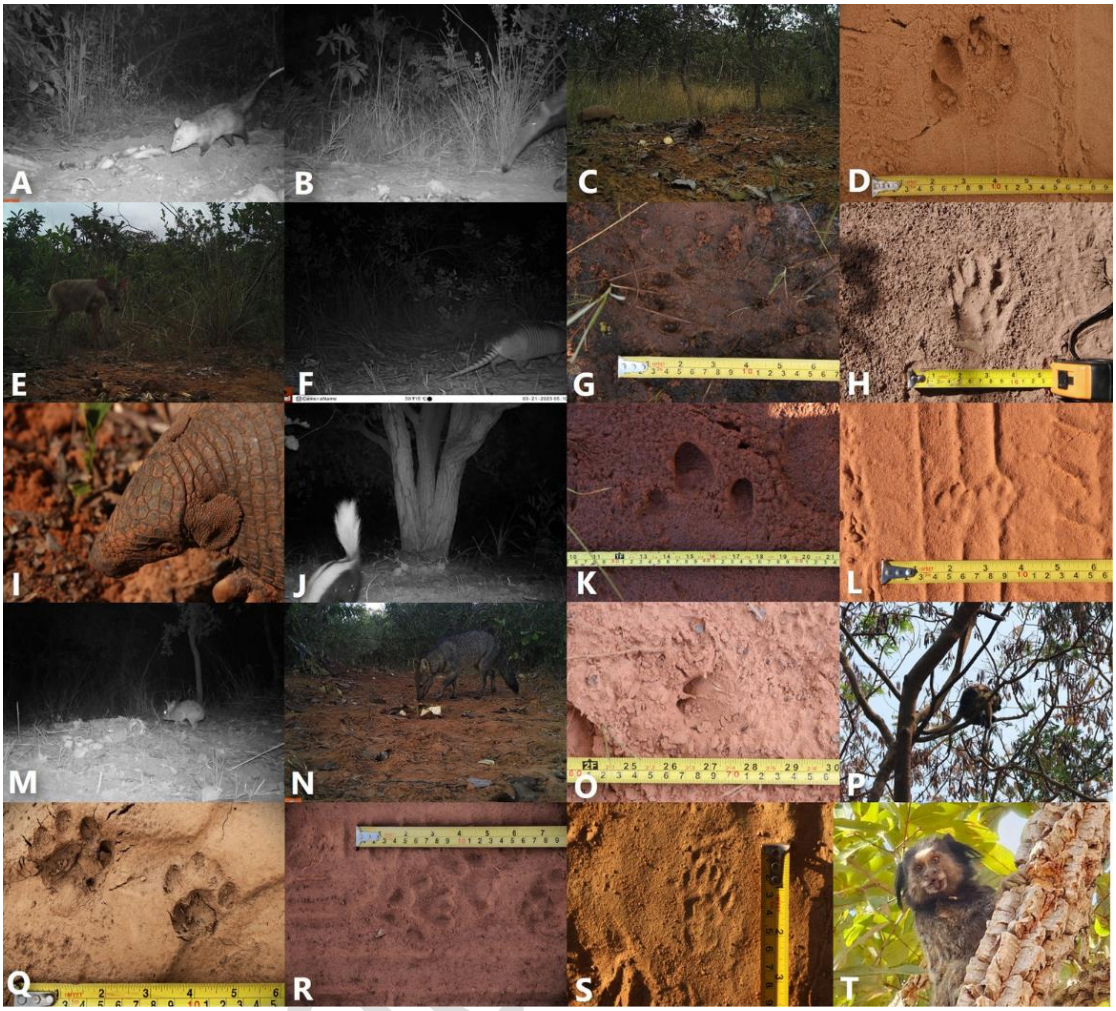

Figure 2. Some of the medium and large-sized mammal species registered in the municipalities of Pirapora and Buritizeiro, state of Minas Gerais, Brazil, within the Cerrado biome. Photos: (A) *Didelphis albiventris,* (B) *Myrmecophaga tridactyla,* (C) *Euphractus sexcinctus*, (D) *Conepatus semistriatus*, (E) *Subulo gouazoubira*, (F) *Dasypus novemcinctus*, (G) *Cuniculus paca*, (H) *Procyon cancrivorus*, (I) *Cabassous squamicaudis*, (J) *Chrysocyon brachyurus*, (K) *Tapirus terrestris*, (L) *Lycalopex vetulus,*(M) *Sylvilagus minensis,* (N) *Cerdocyon thous*, (O) *Dicotyles tajacu*, (P) *Alouatta caraya*, (Q) *Leopardus pardalis*, (R) *Puma concolor*, (S) *Nasua nasua*, (T) *Callithrix penicillata*. Photos by Matheus Correa and Isabel Costa Marques.

The observed species richness curve reached 23 species, while the Jackknife 1 estimator predicted a potential richness of 28.7 species. Although neither curve reached the asymptote, the observed species richness represented approximately 80% of the estimated richness (Figure 3).

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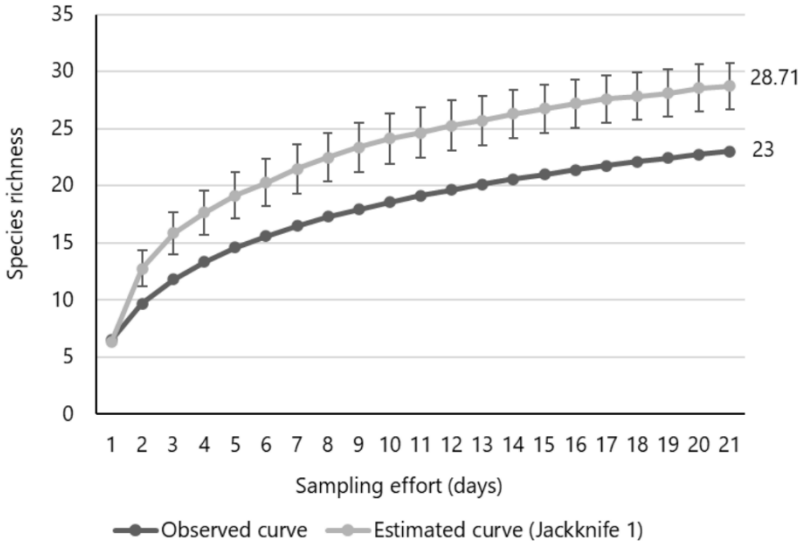

Figure 3. Accumulation curves for medium and large-sized mammal species richness in the municipalities of Pirapora and Buritizeiro, state of Minas Gerais, Brazil. Observed species richness in dark gray. Estimated species richness in clear gray. Vertical lines indicate Standard Deviation (SD) for the Jackknife 1 Estimator.

The Shannon-Weaver diversity index was 2.671, while the Pielou equitability index (J = 0.860) revealed a relatively even distribution of mammal community records, with no species dominance.

Considering previous studies that investigated medium- and large-sized terrestrial mammals in the São Francisco River basin (Fonseca & Silva 2019, Arimoro *et al.* 2020, Pereira *et al.* 2020), 14 species could occur in similar phytophysiognomies, resulting in 58% similarity with our dataset. Cluster analysis using the UPGMA method and the Jaccard similarity index revealed that the primary data from this study shared approximately 60% similarity with two of the secondary studies conducted in riparian forest areas of the São Francisco basin (Pereira *et al.* 2020; Fonseca & Silva 2019) and 52.5% similarity with the study of Arimoro *et al.* 2020 (Figure 4).

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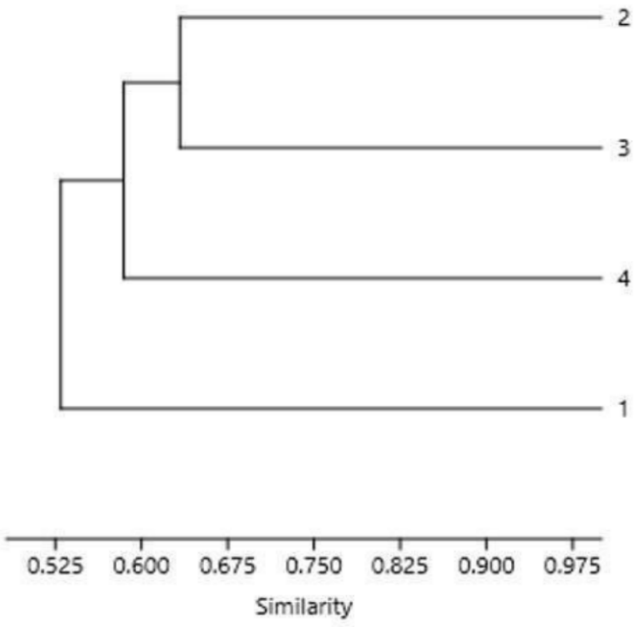

Figure 4. Cluster analysis using the Unweighted Paired Group Method and the Jaccard similarity index between data from studies conducted in the São Francisco River basin and from the present study. Captions: 1 – Arimoro *et al.* (2020); 2 - Pereira *et al.* (2020); 3 - Fonseca *et al.* (2019); 4 – Present study (primary data).

Six species are classified under some level of threat at the state, national, or global level, according to COPAM (2010), ICMBio (2026), and the IUCN (2026), respectively (Table 1). Based on the classification proposed by Gutiérrez & Marinho-Filho (2017) and the ICMBio Salve platform (ICMBio 2026), two species can be considered endemic to the Cerrado: *Callithrix penicillata* (Primates; Cebidae) and *Lycalopex vetulus* (Carnivora; Canidae). Additionally, 11 species are considered cinegetic, as they are commonly targeted for subsistence or recreational hunting and trapping, following the criteria established in Appendices I, II and III of the Convention on International Trade in Endangered Species of Wild Fauna and Flora - CITES (UNEP-WCMC 2025). Among them, *Leopardus pardalis* (Carnivora; Felidae) is listed in Appendix I; *Alouatta caraya* (Primates; Atelidae), *C. penicillata*, *Cerdocyon thous*

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(Carnivora; Canidae), *Chrysocyon brachyurus* (Carnivora; Canidae), *Dicotyles tajacu* (Artiodactyla; Tayassuidae), *Myrmecophaga tridactyla* (Pilosa; Myrmecophagidae), *Puma concolor* (Carnivora; Felidae) and *Tapirus terrestris* (Perissodactyla; Tapiriidae) are listed in Appendix II; and *Cuniculus paca* (Rodentia; Cuniculidae) is listed in Appendix III. Regarding *Leopardus sp*. (Carnivora; Felidae), as there is taxonomic uncertainty, it can be listed in Appendix I or Appendix II. These taxa are subject to various anthropogenic pressures, including habitat loss, hunting, roadkill, and illegal trafficking.

Table 1. Mammal records in the municipalities of Pirapora (PI) and Buritizeiro (BU), state of Minas Gerais, Brazil, within the Cerrado biome. Captions: Method: CT = Camera Trap, IO = Indirect Observation of individuals, footprints, feces, dens or vocalizations; Status: State= COPAM 2010, National = ICMBio 2026, Global = IUCN 2026 (LC= Least Concern, VU= Vulnerable, NT=Near Threatened, DD= Data Deficient).

Taxon	Method	Municipality	Conservation Status		
			State	National	Global
Didelphimorphia					
Didelphidae					
Didelphis albiventris Lund, 1840	CT	BU, PI	-	LC	LC
Cingulata					
Chlamyphoridae					
Euphractus sexcinctus (Linnaeus, 1758)	CT, IO	BU, PI	-	LC	LC
Cabassous squamicaudis (Lund, 1845)	IO	BU, PI	-	LC	LC
Dasypodidae					
Dasypus novemcinctus Linnaeus, 1758	CT, IO	PI	-	LC	LC
Dasypus septemcinctus Linnaeus, 1758	IO	BU	-	LC	LC
Pilosa					
Myrmecophagidae					
Myrmecophaga tridactyla Linnaeus, 1758	CT, IO	BU	VU	VU	VU
Primates					
Atelidae					
Alouatta caraya (Humboldt, 1812)	IO	PI	-	NT	NT
Cebidae					
Callithrix penicillata (É. Geoffroy in Humboldt 1812)	IO	BU, PI	-	LC	LC

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Taxon	Method	Municipality	Conservation Status		
			State	National	Global
Lagomorpha					
Leporidae					
Sylvilagus minensis Thomas, 1901	CT, IO	BU, PI	-	LC	-
Rodentia					
Cuniculidae					
Cuniculus paca (Linnaeus, 1766)	IO	BU	-	LC	LC
Dasyproctidae					
Dasyprocta azarae Lichtenstein, 1823	CT	BU	-	LC	DD
Carnivora					
Mephitidae					
Conepatus semistriatus (Boddaert, 1785)	CT	BU, PI	-	LC	LC
Procyonidae					
Nasua nasua (Linnaeus, 1766)	IO	PI	-	LC	LC
Procyon cancrivorus Cuvier, 1798	IO	BU, PI	-	LC	LC
Canidae					
Cerdocyon thous (Linnaeus, 1766)	CT, IO	BU, PI	-	LC	LC
Chrysocyon brachyurus (Illiger, 1815)	IO	BU, PI	VU	VU	NT
Lycalopex vetulus (Lund, 1842)	IO	BU, PI	-	NT	NT
Felidae					
Leopardus sp.	IO	BU	-	-	-
Leopardus pardalis (Linnaeus, 1758)	IO	BU	VU	-	LC
Puma concolor (Linnaeus, 1771)	IO	PI	VU	NT	LC
Perissodactyla					
Tapiridae					
Tapirus terrestris (Linnaeus, 1758)	CT, IO	BU, PI	EN	VU	VU
Artiodactyla					
Cervidae					
Subulo gouazoubira (Fischer, 1814)	CT, IO	BU, PI	-	LC	LC
Tayassuidae					
Dicotyles tajacu (Linnaeus, 1758)	IO	BU	VU	LC	LC

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DISCUSSION

The species richness recorded in this study reflects the importance of local surveys in fragmented Cerrado landscapes, particularly in areas not included within protected networks. The detection of 23 species through primary data, representing over 80% of the potential regional species richness, highlights the relevance of using complementary non-invasive methods to assess mammalian fauna in anthropogenically altered environments.

The combined use of camera traps and active search proved essential, as 48% of the species were exclusively detected through active search and 13% only through camera trapping. This result underscores the importance of methodological complementarity, particularly when dealing with species that are elusive, nocturnal, or occur at low densities, such as felids (Voss & Emmons 1996, Sanderson & Trolle 2005, Melo *et al.* 2012, Carvalho *et al.* 2016).

Although the species accumulation curve did not reach an asymptote, the proximity of the observed richness to the Jackknife 1 estimate suggests that the sampling effort was effective in capturing a representative subset of the local mammalian community. These findings align with other studies in the Neotropics that emphasize the need for extended sampling to approach total mammal species richness (Moreno & Halffter 2000, Mourthé 2013, Bovendorp *et al.* 2017).

The Shannon-Weaver diversity index obtained in this study (H' = 2.671), together with Pielou's evenness index (J = 0.852), indicates a robust diversity and a relatively uniform distribution of species (Magurran 1988, 2011). These values corroborate the results reported by Rocha & Dalponte (2006) in the Municipal Biological Reserve "Mário Viana," in the state of Mato Grosso (H' = 2.40), by Farias *et al.* (2020) in the Ituverava Solar Complex in the state of Bahia, where indices ranged from H' = 2.1 to H' = 2.6, and similarly by Ferreira (2008b), who recorded H' = 2.05 in the Cavernas do Peruaçu National Park, northern Minas Gerais. These studies reinforce the trend of high diversity across different areas of the Cerrado biome. In contrast, Bristot (2013), in a study conducted in the municipality of Arenópolis, state of Goiás,

reported lower values, ranging from H’ = 0.859 to H' = 1.033, possibly due to the analyses being carried out separately for each sampling campaign. Thus, the results of the present study prove to be consistent with the diversity patterns reported in other Cerrado regions. The similarity analysis between datasets indicated that the mammal assemblage recorded in this study shows a high correspondence with those described in other riparian areas of the Cerrado. This pattern may reflect habitat continuity along river corridors, which often act as refuges for wildlife in fragmented landscapes, thereby favoring the maintenance of similar species assemblages in these environments (Fonseca *et al.* 2019, Pereira *et al.* 2020).

However, it is important to consider that the studies used for comparison differ substantially in terms of sampling methods, sampling effort, survey duration, and the spatial extent of the investigated area factors that directly influence species detectability. For instance, Fonseca *et al.* (2019) conducted surveys over a period of 28 months (2013–2015) in an area of 76.5 ha using visual censuses, records of indirect signs, and camera traps. Similarly, Pereira *et al.* (2020) carried out monitoring between March 2015 and November 2016 in the Rio Pandeiros Environmental Protection Area, covering a much larger area of 396,060 ha and relying mainly on camera traps complemented by indirect records such as tracks and feces. In turn, Arimoro *et al.* (2020) conducted their survey in the Formosa Military Training Area, encompassing an area of approximately 15,000 ha, using 50 camera traps arranged in a systematic grid with a minimum average distance of 2 km between devices, operating continuously from August 2014 to May 2015.

Therefore, although the results indicate patterns of similarity among the recorded assemblages, such comparisons should be interpreted with caution because methodological, temporal, and spatial differences may influence the composition of detected species. Nevertheless, the observed convergence suggests that riparian environments of the Cerrado in the middle São Francisco River region play an important role in maintaining similar

communities of medium- and large-sized mammals. Species such as *C. squamicaudis*, *D. albiventris*, and *S. gouazoubira* were among the most frequently recorded, reinforcing their adaptability to human-modified landscapes. These taxa are commonly associated with open areas, pasturelands, and degraded habitats and may benefit from reduced competition or predator pressure in such contexts. Their prevalence in disturbed matrices has been reported in other regions of the Cerrado (Rodrigues *et al.* 2014, Rodrigues *et al.* 2017, Almeida *et al.* 2020, Feijó & Anacleto 2021, Machado *et al.* 2021, Desbiez *et al.* 2022).

The eight threatened or near-threatened species identified in our study highlight the vulnerability of Cerrado mammals to habitat degradation and direct human impacts. Threats such as habitat conversion, poaching, roadkill, and illegal wildlife trade remain persistent concerns. Species of higher conservation concern, such as *M. tridactyla* and *C. brachyurus*, are often victims of these pressures and require targeted conservation actions (Chiarello *et al.* 2008, ICMBio 2018).

The presence of 11 cinegetic species in the study area also raises attention to the potential impact of subsistence and opportunistic trapping and hunting. In many rural regions of Brazil, hunting remains a common practice (Chiarello 2000b, Cuaron 2000), especially in areas lacking formal protection or environmental enforcement (Costa *et al.* 2005). These practices, coupled with habitat loss, can further reduce population viability for heavily targeted species (Canale *et al.* 2012, Srbek-Araujo & Kierulff 2016).

Considering the taxa that can be classified as endemic to the Cerrado, recorded within the study site, it is important to note that *C. penicillata*, although originally restricted to the Cerrado (Gutiérrez & Marinho-Filho 2017), is present in areas of the Atlantic Forest and Caatinga biomes (Prezoto 2015, Guimarães-Lopes *et al.* 2025). It is considered an invasive species in these areas because of illegal trade (Guimarães-Lopes *et al.* 2025), causing impacts such as predation on native fauna, disease transmission, hybridization, and competition with native species (Sampaio

& Schmidt 2013, ICMBio 2018, Guimarães-Lopes *et al.* 2025). *Lycalopex vetulus* has also been reported in ecotonal regions between the Cerrado and adjacent biomes, including the Pantanal (Paglia *et al.* 2012, Dalponte *et al.* 2018), the Amazon (Dalponte *et al.* 2018), the Caatinga (Gutiérrez & Marinho-Filho 2017, Abra *et al.* 2020) and the Atlantic Rainforest (Laurindo *et al.* 2025). Rather than being introduced, *L. vetulus* occupies ecotonal or altered environments, probably due to the degradation or absence of their characteristic native habitats (Laurindo *et al.* 2025), which may also occur with other South American canids, such as *Lycalopex gymnocercus* (Carnivora; Canidae) (Magioli *et al.* 2016, Brocardo *et al.* 2020) and *C. brachyurus* (Xavier *et al.* 2017, Silva-Diogo *et al.* 2020). *Lycalopex vetulus* is also considered "Near Threatened" both globally (IUCN 2026) and nationally (ICMBio 2026). During fieldwork, one deceased specimen of *L. vetulus* was found in the study area on account of a roadkill, reinforcing how road killing represents a major threat for the species (Lemos *et al.* 2018).

Overall, this study reinforces the importance of faunal surveys in poorly sampled regions of the Cerrado, contributing to expanding knowledge about the mammalian fauna, reducing gaps related to species distribution, and supporting biodiversity assessments and conservation strategies. In the municipalities of Buritizeiro and Pirapora, the results reveal the resilience of the mammal community, even in a region historically modified by human activities. Beyond their scientific value, these findings can support environmental education initiatives, environmental management actions, and impact mitigation measures, such as the implementation of road signage in areas with higher wildlife occurrence, contributing to the reduction of wildlife roadkills and to the planning of conservation actions in landscapes under increasing environmental pressure (Bager & Rosa 2010, Correia *et al.* 2020).

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