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TEMPORAL ECOLOGY OF DASYPROCTA AZARAE (RODENTIA, DASYPROCTIDAE) IN CENTRAL BRAZIL

ECOLOGIA TEMPORAL DE DASYPROCTA AZARAE (RODENTIA, DASYPROCTIDAE) NO BRASIL CENTRAL

ECOLOGÍA TEMPORAL DE DASYPROCTA AZARAE (RODENTIA, DASYPROCTIDAE) EN BRASIL CENTRAL

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ABSTRACT

Dasyprocta azarae is widely distributed across South America and plays an important role in secondary seed dispersal. Although it is considered common in several regions, information on its abundance and temporal ecology in the Brazilian Cerrado remains scarce. This study evaluated the relative abundance, activity pattern, and temporal overlap of this species in Central Brazil. Data were collected between 2019 and 2023 using Bushnell® Trophy Cam camera traps installed in the Planalto Central Environmental Protection Area, Federal District, Brazil. The total sampling effort reached 9,633 camera-trap days, resulting in 267 records of the species, of which 198 were considered independent. Dasyprocta azarae showed low relative abundance and a predominantly diurnal activity pattern, with two activity peaks concentrated in the morning and late afternoon. The highest temporal overlap was observed with Eira barbara (Dhat = 0.79), whereas Leopardus pardalis (Dhat = 0.14), Hydrochoerus hydrochaeris (Dhat = 0.20), and Cuniculus paca (Dhat = 0.06) showed low overlap values. The activity pattern recorded corroborates previous studies for the species; however, the low abundance observed contrasts with records from other areas within its distribution range, suggesting that local factors may influence its distribution and abundance in the Cerrado of Central Brazil.

Keywords: Diel Activity Pattern. Camera Trapping. Temporal Niche Overlap. Terrestrial Mammals. Biological Conservation.

RESUMO

Dasyprocta azarae é amplamente distribuída na América do Sul e desempenha importante função na dispersão secundária de sementes. Apesar de ser considerada comum em diversas regiões, informações sobre sua abundância e ecologia temporal no Cerrado brasileiro ainda são escassas. Este estudo avaliou a abundância relativa, o padrão de atividade e a sobreposição temporal desta espécie no Brasil Central. Os dados foram obtidos

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entre 2019 e 2023 por meio de armadilhas fotográficas Bushnell® Trophy Cam instaladas na Área de Proteção Ambiental do Planalto Central, Distrito Federal. O esforço amostral total foi de 9.633 armadilhas-dia, resultando em 267 registros da espécie, dos quais 198 foram considerados independentes. Dasyprocta azarae apresentou baixa abundância relativa e padrão de atividade predominantemente diurno, com dois picos de atividade concentrados no período da manhã e no final da tarde. A maior sobreposição temporal foi observada com Eira barbara (Dhat = 0,79), enquanto Leopardus pardalis (Dhat = 0,14), Hydrochoerus hydrochaeris (Dhat = 0,20) e Cuniculus paca (Dhat = 0,06) apresentaram baixa sobreposição. Os resultados corroboram o padrão de atividade previamente descrito para a espécie, porém diferem quanto à abundância, considerada baixa na área de estudo quando comparada a outras áreas de ocorrência, sugerindo que fatores locais podem influenciar sua distribuição e abundância no Cerrado do Brasil Central.

Palavras-chave: Padrão de Atividade Diária. Armadilhamento Fotográfico. Sobreposição Temporal de Nicho. Mamíferos Terrestres. Conservação Biológica.

RESUMEN

Dasyprocta azarae se distribuye ampliamente en América del Sur y desempeña un importante papel en la dispersión secundaria de semillas. Aunque se considera una especie común en varias regiones, la información sobre su abundancia y ecología temporal en el Cerrado brasileño aún es escasa. Este estudio evaluó la abundancia relativa, el patrón de actividad y la superposición temporal de esta especie en Brasil Central. Los datos fueron obtenidos entre 2019 y 2023 mediante cámaras trampa Bushnell® Trophy Cam instaladas en el Área de Protección Ambiental del Planalto Central, Distrito Federal, Brasil. El esfuerzo total de muestreo fue de 9.633 días-cámara, generando 267 registros de la especie, de los cuales 198 fueron considerados independientes. Dasyprocta azarae presentó baja abundancia relativa y un patrón de actividad predominantemente diurno, con dos picos de actividad concentrados en la mañana y al final de la tarde. La mayor superposición temporal se observó con Eira barbara (Dhat = 0,79), mientras que Leopardus pardalis (Dhat = 0,14), Hydrochoerus hydrochaeris (Dhat = 0,20) y Cuniculus paca (Dhat = 0,06) presentaron baja superposición. El patrón de actividad registrado coincide con lo descrito previamente para la especie; sin embargo, la baja abundancia observada contrasta con la registrada en otras áreas de su distribución, lo que sugiere que factores locales pueden influir en su distribución y abundancia en el Cerrado de Brasil Central.

Palabras clave: Patrón de Actividad Diaria. Fototrampeo. Superposición Temporal de Nicho. Mamíferos Terrestres. Conservación Biológica.

1 INTRODUÇÃO

The Cerrado is one of the world's largest and most biodiverse tropical savannas and is recognized as a global biodiversity hotspot (Myers *et al.*, 2000). Recent large-scale surveys have identified the Brazilian Cerrado as the most plant-diverse savanna on Earth, reinforcing its global conservation value (Giles *et al.*, 2026). The biome also supports a diverse vertebrate fauna, including 227 mammal species distributed across 126 genera (Carmignotto *et al.*, 2012). Despite its ecological importance, the biome has undergone extensive habitat loss and fragmentation, mainly driven by agricultural expansion and other human disturbances, raising concerns about the conservation of its wildlife populations (Klink; Machado, 2005; Alencar *et al.*, 2020; Pompeu *et al.*, 2024).

Among the mammals occurring in the Cerrado, rodents constitute the most diverse order, accounting for 78 species in the biome (Carmignotto *et al.*, 2012). Azara's agouti (Dasyprocta azarae Lichtenstein, 1823) is broadly distributed across central and southern South America, with confirmed records in Brazil, Paraguay, and Argentina, although its presence in Bolivia is still uncertain (Mejía-Fontecha *et al.*, 2022). The species inhabits a variety of environments, including Cerrado formations, semideciduous forests, gallery forests, and Atlantic Forest remnants (Bonvicino *et al.*, 2008; Patton; Emmons, 2015; Mejía-Fontecha *et al.*, 2022). It plays an important ecological role as both a seed predator and secondary seed disperser through scatter-hoarding behavior, influencing seed survival, plant recruitment, and regeneration dynamics in Neotropical ecosystems (Almeida; Galetti, 2007; Galetti *et al.*, 2015).

Although Azara's agouti is considered a common species throughout much of its distribution and is currently classified as Least Concern in Brazil (Percequillo *et al.*, 2024), important knowledge gaps remain regarding its ecology, population dynamics, and responses to environmental pressures. According to the most recent national assessment, studies addressing the species' ecology, natural history, population status, and the impacts of potential threats such as hunting and habitat degradation remain research priorities (Percequillo *et al.*, 2024). At the global level, D. azarae remains classified as Data Deficient by the IUCN due to insufficient information on population trends and ecological requirements (Catzeflis *et al.*, 2016).

Information on activity patterns and temporal interactions with sympatric species provides important insights into resource use, species coexistence, and predator-prey relationships, helping to elucidate how mammals respond to environmental conditions and human disturbance (Mayer *et al.*, 2023; Wooster *et al.*, 2026). Camera trapping has become

one of the most widely used non-invasive approaches for investigating mammalian activity patterns, habitat use, and temporal interactions, allowing the estimation of relative abundance and temporal overlap among species (Srbek-Araujo; Chiarello, 2007; Mayer *et al.*, 2023). Despite the broad distribution of D. azarae, studies addressing its temporal ecology, activity patterns, and abundance in the Cerrado remain scarce, particularly within protected areas of Central Brazil.

This study evaluated the temporal ecology of Dasyprocta azarae in the Planalto Central Environmental Protection Area (APAPC), Federal District, Brazil, using camera-trap records collected between 2019 and 2023. Specifically, the objectives were to: (i) estimate the relative abundance of D. azarae in the study area; (ii) characterize its diel activity pattern; and (iii) quantify temporal overlap between D. azarae and sympatric mammals with potential trophic or ecological interactions in the study area.

2 REFERENCIAL TEÓRICO

2.1 TAXONOMY, DISTRIBUTION, AND ECOLOGICAL ROLE

The genus Dasyprocta includes 13 recognized species of large Neotropical rodents found across the Neotropics (Patton; Emmons, 2015). Dasyprocta azarae occurs in central South America, with confirmed records in Brazil, Paraguay, and Argentina, although its occurrence in Bolivia remains uncertain (Mejía-Fontecha *et al.*, 2022). Throughout its distribution, the species occupies a variety of forested and savanna habitats, including Cerrado formations, semideciduous forests, and gallery forests associated with watercourses (Reis *et al.*, 2006; Patton; Emmons, 2015).

Dasyprocta azarae is a medium-sized terrestrial rodent with body mass ranging from approximately 2.3 to 3.5 kg (Reis *et al.*, 2006). The species is primarily frugivorous-granivorous and plays an important ecological role as both a seed predator and secondary seed disperser (Paglia *et al.*, 2012). By scatter-hoarding, individuals bury seeds for later consumption, but many of these cached seeds are never retrieved, which promotes seed survival, plant recruitment, and forest regeneration. As a result, agoutis play an important role in Neotropical ecosystem functioning and seed dynamics, influencing vegetation structure and regeneration processes (Galetti *et al.*, 2015). More broadly, seed dispersal by animals is one of the most important ecological functions performed by terrestrial vertebrates, supporting plant recruitment, ecosystem resilience, and vegetation recovery after disturbance (Fricke *et al.*, 2025).

Although D. azarae is currently classified as Least Concern in Brazil, recent national assessments have emphasized important knowledge gaps regarding its ecology, population

dynamics, and responses to anthropogenic pressures (Percequillo *et al.*, 2024). At the global level, the species was previously classified as Data Deficient because of insufficient information on population trends and ecological requirements (Catzeflis *et al.*, 2016), while its population trend has been considered declining. These knowledge gaps highlight the importance of studies investigating the ecology, abundance, and population status of the species across different regions of its distribution.

2.2 ACTIVITY PATTERN

Activity patterns are a fundamental component of mammalian ecology because they influence resource acquisition, predator avoidance, habitat use, reproductive behavior, and interactions among species (Kronfeld-Schor; Dayan, 2003; Mayer *et al.*, 2023; Wooster *et al.*, 2026). Temporal activity schedules are shaped by both intrinsic factors, such as physiological requirements, and extrinsic factors, including temperature, food availability, predation risk, and human disturbance (Mayer *et al.*, 2023). Consequently, variation in activity patterns may reflect behavioral responses to environmental conditions and ecological interactions within mammalian communities.

Dasyprocta azarae is generally regarded as a predominantly diurnal species. Camera-trap studies conducted in different regions of central South America have consistently reported activity concentrated during daylight hours, with little or no nocturnal activity (Negrões *et al.*, 2011; Cid *et al.*, 2015). Similar patterns have been documented for other species of the genus, including Dasyprocta punctata in Central America and Dasyprocta leporina in Amazonian and Atlantic Forest environments, suggesting that diurnality may represent a conserved behavioral trait within Dasyprocta (Gómez *et al.*, 2005; Lambert *et al.*, 2009; Norris *et al.*, 2010; Magalhães; Srbek-Araujo, 2019).

Although diurnality predominates, activity schedules may vary according to environmental conditions. In the Pantanal, Cid *et al.* (2015) demonstrated that D. azarae adjusts its daily activity in response to temperature, exhibiting more concentrated activity during cooler periods of the day when thermal conditions are less restrictive. Similar effects have been reported for congeners inhabiting tropical forests, where local climatic conditions influence the distribution of activity throughout the diel cycle (Magalhães; Srbek-Araujo, 2019). These findings indicate that thermal conditions may act as important proximate drivers of activity timing, particularly in highly seasonal environments such as the Cerrado.

Behavioral plasticity in activity schedules may also arise from ecological interactions and anthropogenic pressures. Changes in activity timing can reduce encounters with predators, minimize competition for resources, and facilitate coexistence among sympatric

species (Kronfeld-Schor; Dayan, 2003; Mayer *et al.*, 2023; Wooster *et al.*, 2026). In human-modified landscapes, shifts in activity patterns have been documented for numerous mammal species as a response to habitat disturbance and increasing human presence, often resulting in greater temporal segregation from periods of intense human activity (Gaynor *et al.*, 2018; Mayer *et al.*, 2023).

In the Cerrado, D. azarae occurs in mammal assemblages that include other large frugivores and granivores, such as Cuniculus paca, as well as potential predators including felids and mustelids (Hannibal *et al.*, 2021). Understanding the temporal activity patterns of D. azarae and their overlap with sympatric species may therefore provide valuable insights into resource use, species interactions, and mechanisms promoting coexistence within Cerrado mammal communities.

2.3 TEMPORAL OVERLAP AND NICHE PARTITIONING

Temporal niche partitioning is an important mechanism that promotes coexistence among sympatric species by reducing direct competition for resources and minimizing predation risk through differences in activity schedules (Schoener, 1974; Kronfeld-Schor; Dayan, 2003). Increasing evidence from camera-trap studies indicates that temporal segregation can facilitate species coexistence even when spatial or trophic overlap is substantial, highlighting the role of time as an important dimension of ecological niches (Frey *et al.*, 2017; Lear *et al.*, 2021; Rodríguez-Luna *et al.*, 2024).

Camera trapping has become an important tool for studying temporal interactions among wildlife species. By recording the times when animals are active, these surveys allow researchers to estimate temporal overlap and investigate patterns of coexistence, competition, and predator-prey relationships (Ridout; Linkie, 2009; Mayer *et al.*, 2023).

Temporal overlap does not necessarily imply direct competition, but it may indicate increased opportunities for ecological interactions among species that share habitats or resources. Conversely, temporal segregation may reduce antagonistic interactions and facilitate coexistence within ecological communities (Frey *et al.*, 2017; Rodríguez-Luna *et al.*, 2024). Consequently, analyses of temporal overlap have become an important tool for understanding community structure and niche relationships in mammalian assemblages (Mayer *et al.*, 2023; Wooster *et al.*, 2026).

In the Cerrado, Dasyprocta azarae occurs in mammal assemblages that include other rodents, carnivores, and omnivores, such as Cuniculus paca, Hydrochoerus hydrochaeris, Eira barbara, and Leopardus pardalis (Hannibal *et al.*, 2021). Evaluating temporal overlap between D. azarae and sympatric species may therefore provide valuable insights into

resource use, ecological interactions, and coexistence mechanisms within mammalian communities of Central Brazil.

2.4 HABITAT USE AND ABUNDANCE

Dasyprocta azarae occupies a wide variety of habitats throughout its distribution, including tropical forests, semideciduous forests, gallery forests, Cerrado formations, and human-modified landscapes containing remnant native vegetation (Reis *et al.*, 2006; Bonvicino *et al.*, 2008; Patton; Emmons, 2015). However, within predominantly savanna landscapes, the occurrence of the species appears to be strongly influenced by the availability and spatial configuration of forested habitats. In the Brazilian Cerrado, Amiot *et al.* (2021) found that the occurrence of D. azarae was associated with forest cover and edge density at multiple spatial scales, highlighting the importance of wooded habitats, gallery forests, forest edges, and riparian vegetation for the species.

Human-induced disturbances may also affect habitat use and population persistence. Hunting has been identified as an important driver of local population declines in several Neotropical regions, particularly in fragmented landscapes where enforcement is limited (Cullen *et al.*, 2001). More recently, Bardales *et al.* (2024) documented a substantial decline in occupancy of D. azarae following the Pantanal megafires of 2020, suggesting sensitivity to large-scale habitat disturbances.

Available estimates indicate substantial geographic variation in abundance. In the Pantanal, population densities ranged from approximately 1.2 individuals km^{-2} in open grasslands to more than 10 individuals km^{-2} in forest-dominated habitats (Desbiez *et al.*, 2010). Other studies have described D. azarae as locally common or abundant in protected areas and well-preserved landscapes (Rocha; Dalponte, 2006). However, quantitative information on abundance remains scarce throughout much of the species' distribution, particularly in the Cerrado, where most available data are limited to occurrence records, occupancy estimates, or relative abundance indices.

Recent national assessments have highlighted the lack of information regarding population size, abundance patterns, and demographic trends across the species' distribution (Percequillo *et al.*, 2024). Consequently, studies evaluating abundance and habitat use in different Cerrado landscapes remain important for improving our understanding of the ecological requirements and conservation status of D. azarae.

3 MATERIALS AND METHODS

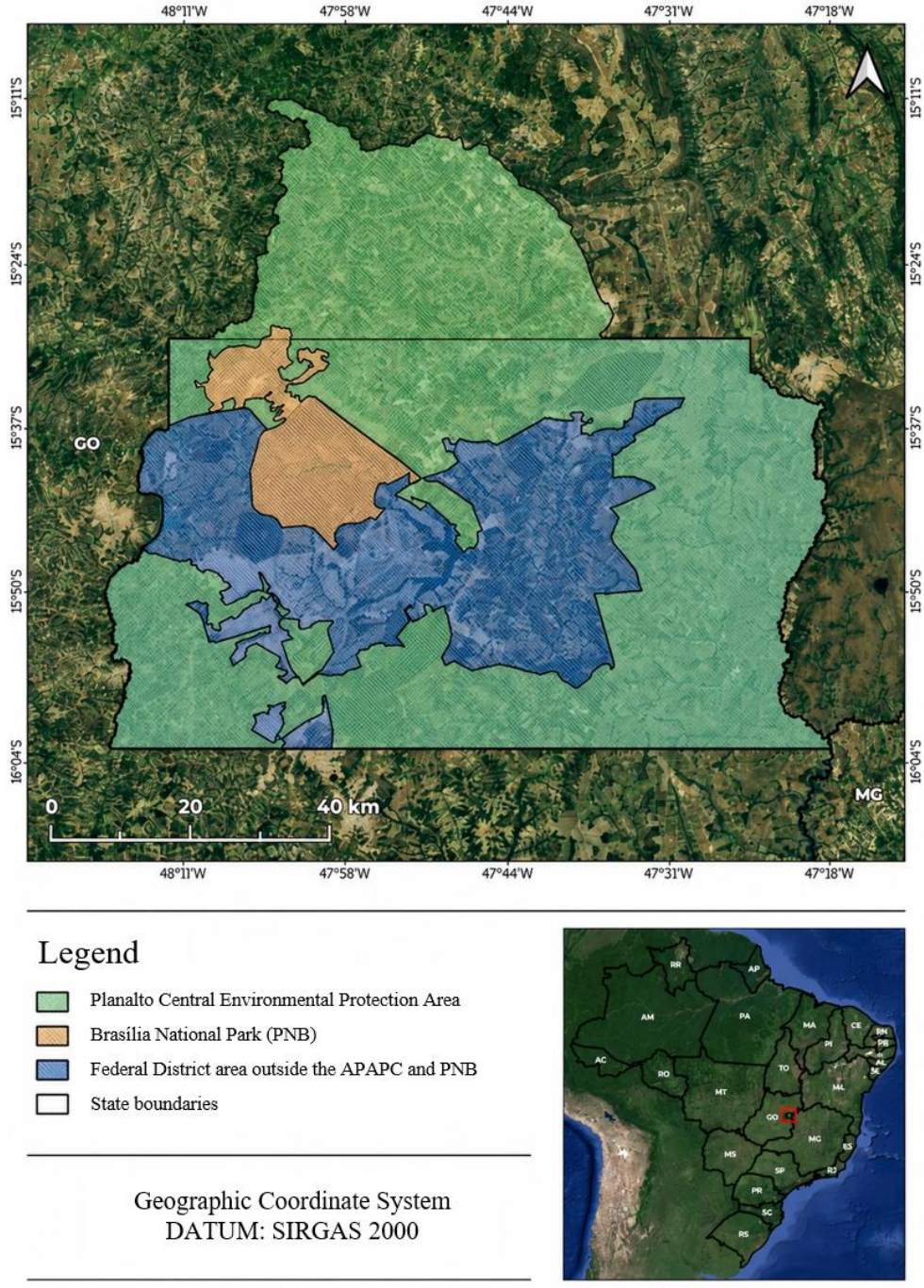
3.1 STUDY AREA

The study was conducted in the Planalto Central Environmental Protection Area (Área de Proteção Ambiental do Planalto Central - APAPC; Figure 1), a sustainable-use protected area located in Central Brazil and encompassing portions of the Federal District and the state of Goiás. The APAPC was established in 2002 and covers approximately 504,160 ha, of which about 75% lies within the Federal District (Brasil, 2002; Brasil, 2012). The protected area contains a heterogeneous mosaic of Cerrado physiognomies, including cerrado sensu stricto, gallery forests, dry forests, palm swamps (veredas), and grassland formations, representing important habitats for a diverse assemblage of mammals and other vertebrates. The regional climate is classified as tropical savanna (Aw, Köppen), characterized by marked seasonality, with most rainfall concentrated between September/October and March/April and a dry season extending from April/May to September. Annual precipitation in the Federal District generally ranges from approximately 1,000 to 1,600 mm (Alvares *et al.*, 2013; IPE, 2020).

Camera-trap surveys were conducted throughout the APAPC as part of the Large and Medium Mammals Monitoring Program coordinated by the Chico Mendes Institute for Biodiversity Conservation (ICMBio).

Figure 1

Location of the Planalto Central Environmental Protection Area (APAPC), Federal District, Brazil



Source: elaborated by the authors, 2026.

3.2 CAMERA-TRAP SURVEY AND DATA PROCESSING

Mammal records were obtained through a camera-trap monitoring program conducted within the APAPC between September 2019 and December 2023. Camera surveys were carried out using Bushnell® Trophy Cam camera traps installed in different Cerrado

physiognomies. Between 2019 and 2022, 12 camera traps were deployed, whereas in 2023 the sampling design was expanded to 30 units.

Camera stations were established in locations showing evidence of animal activity or presenting high potential for wildlife occurrence, including trails, stream crossings, forest edges, and areas with signs of animal movement. The average distance between camera stations was approximately 500 m.

Cameras were attached on trees at heights ranging from 15 to 40 cm above ground level and programmed to operate continuously (24 h day^{-1}). Devices were configured to record 30-second videos with a 1-second interval between triggers. Camera stations were inspected periodically for maintenance, battery replacement, and memory card exchange.

Independent records were defined as consecutive detections of the same species separated by at least 60 min at the same camera station (Srbek-Araujo; Chiarello, 2013). For each independent record, the date, time, and camera station were extracted for subsequent analyses. Representative camera-trap records of Dasyprocta azarae obtained during the monitoring program are provided in Appendix A.

3.3 DATA ANALYSIS

3.3.1 Relative abundance

Relative abundance of Dasyprocta azarae was estimated using a Relative Abundance Index (RAI), expressed as the number of independent records per 100 camera-trap days, according to Equation 1. This index is commonly used in camera-trap studies as a trapping rate and proxy for relative abundance (O'Brien; Kinnaird; Wibisono, 2003), although it should be interpreted with caution because detection probability may be influenced by camera placement, species behavior, habitat structure, and camera model (Srbek-Araujo; Chiarello, 2013; Wearn; Glover-Kapfer, 2017).

$$RAI = (n_i / N) \backslash times\ 100 \quad (1)$$

Where: RAI = Relative Abundance Index, expressed as independent records per 100 camera-trap days; n_i = number of independent records of Dasyprocta azarae; N = total sampling effort, expressed in camera-trap days

3.3.2 Activity pattern

The activity pattern of Dasyprocta azarae was analyzed using the time of each independent camera-trap record. Detection times were converted into circular data and used

to estimate the diel activity distribution of the species over a 24-hour cycle. Activity curves were generated using kernel density estimation in R software.

Independent records were classified according to the proportion of detections occurring during diurnal, nocturnal, and crepuscular periods. Sunrise and sunset times were obtained for Brasília, Federal District, according to the date of each record. Diurnal periods were defined as the interval from one hour after sunrise to one hour before sunset; nocturnal periods as the interval from one hour after sunset to one hour before sunrise; and crepuscular periods as the intervals between one hour before and one hour after sunrise and sunset, following Theuerkauf *et al.* (2003). Activity categories were interpreted according to Jiménez *et al.* (2010).

3.3.3 Temporal overlap

Temporal overlap between Dasyprocta azarae and sympatric mammal species recorded in the study area was estimated using the coefficient of overlap (Δ), based on kernel density functions of diel activity patterns. The coefficient ranges from 0, indicating no temporal overlap, to 1, indicating complete overlap (Ridout; Linkie, 2009).

Overlap analyses were performed in R using the package overlap. Because some species had relatively small numbers of independent records, the estimator Dhat1 was used for all pairwise comparisons. This estimator is recommended for small sample sizes and was applied consistently to compare the activity pattern of D. azarae with those of Eira barbara, Leopardus pardalis, Cuniculus paca, and Hydrochoerus hydrochaeris.

Species selected for temporal overlap analyses included sympatric mammals with potential trophic or ecological interactions with D. azarae. These included potential predators or opportunistic omnivores, such as Eira barbara and Leopardus pardalis, and species that may share food resources or habitat use, such as Cuniculus paca and Hydrochoerus hydrochaeris. Species with very low numbers of independent records were excluded from the overlap analyses. The number of independent records used in each comparison was: D. azarae × E. barbara = 198/19 records; D. azarae × L. pardalis = 198/26 records; D. azarae × C. paca = 198/41 records; and D. azarae × H. hydrochaeris = 198/28 records. For each species pair, activity curves were compared to assess the degree of temporal overlap with D. azarae.

3.4 USE OF ARTIFICIAL INTELLIGENCE TOOLS

In accordance with CNPq Portaria nº 2.664/2026, the authors declare that generative artificial intelligence tools were used during the preparation of this manuscript, as follows:

Claude (Anthropic) was used to assist with English language editing and improvement of textual organization; ChatGPT (OpenAI) was used solely to assist with the visual improvement of figures originally produced in R software. All data analyses underlying the figures were performed exclusively by the authors using R. No AI tool was used for data collection, data analysis, interpretation of results, or generation of scientific content. The authors assume full responsibility for the integrity and accuracy of all content, including any errors or inaccuracies that may have resulted from the use of these tools.

4 RESULTS AND DISCUSSION

4.1 RELATIVE ABUNDANCE

From September 2019 to December 2023, camera traps recorded 1,675 mammal detections across 78 sampling stations in the Planalto Central Environmental Protection Area. The total sampling effort was 9,633 camera-trap days. Of these detections, 267 were assigned to Dasyprocta azarae, and 198 were treated as independent records based on a 60-minute interval criterion.

The Relative Abundance Index (RAI) of D. azarae was 2.06 independent records per 100 camera-trap days, suggesting low relative abundance in the study area. This pattern was reinforced by the restricted spatial distribution of records, as the species was recorded at only three of the 78 monitored sampling stations, corresponding to 3.8% of the camera stations (Figure 2).

Regarding the temporal distribution of records, no records were obtained in 2019 or 2020. In 2021, the species was detected in a Cerrado area; in 2022, eight records were obtained in gallery forest; and in 2023, most records were concentrated in gallery forest at Pousada Villa Triacca, a private rural property surrounded by agricultural land. However, the temporal distribution of records among years should be interpreted with caution because sampling effort was not constant throughout the monitoring period, with an expansion in the number of camera traps in 2023. Therefore, differences among years may reflect both variation in species occurrence and changes in sampling design. These results were compared with abundance and occurrence data available for Dasyprocta azarae in other Neotropical camera-trap studies (Table 1).

Table 1

Relative abundance indices reported for Dasyprocta azarae in camera-trap studies

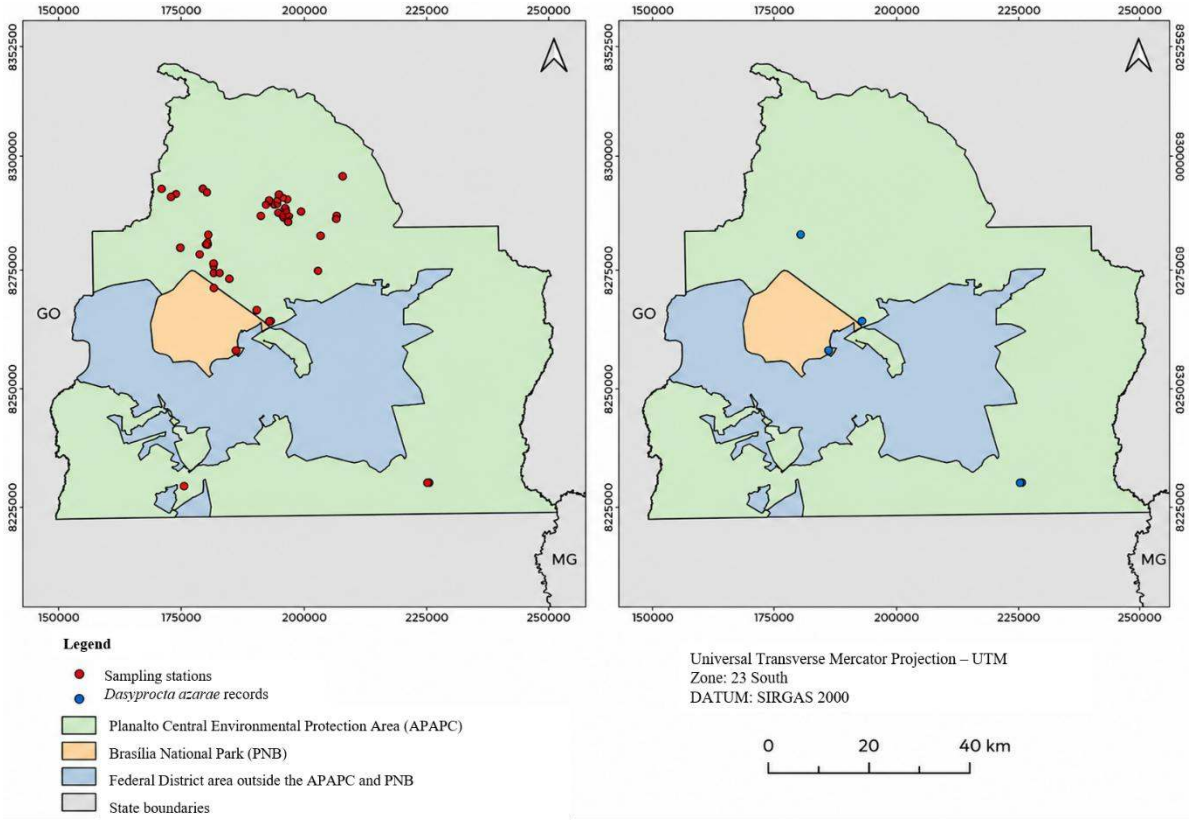
Study area	Sampling effort	Records	RAI	Reference
Planalto Central Environmental Protection Area, Federal District, Brazil	9,633 camera-trap days	198 independent records; 267 total records	2.06 independent records/100 camera-trap days	Present study
Urucum Massif, Mato Grosso do Sul, Brazil	2,403 camera-days	229 independent records	0.095; equivalent to 9.53 records/100 camera-trap days	Assis *et al.* (2022)
Serra do Amolar, Brazilian Pantanal	6,016 trap-nights	311 detections / independent records	5.17 records/100 camera-trap nights*	Bardales *et al.* (2024)
São Francisco de Paula National Forest, Rio Grande do Sul, Brazil	10,844 camera-trap days	409 independent records	3.77 records/100 camera-trap days*	Marques; Fabián (2018)
Turvo State Park, Rio Grande do Sul, Brazil	Four camera-trap campaigns	432 photographic records	CPUE = 30.3–32.1 records/100 trap-nights	Kasper *et al.* (2007)

Source: elaborated by the authors based on the cited studies and data from the present study. Note: Values are not fully comparable because studies differ in sampling design, effort units, camera placement, habitat type and independence criteria. Asterisks indicate values standardized here from data reported by the authors. CPUE = capture per unit effort; RAI = relative abundance index.

The RAI observed in the APAPC was lower than values reported for D. azarae in other regions, although comparisons should be made with caution because sampling design, effort, habitat type, and independence criteria differ among studies. In the Urucum Massif, in the Brazilian Pantanal, D. azarae had 229 independent records and a trapping rate of 0.095 records per camera-day, equivalent to 9.53 records per 100 camera-days, being one of the species with the highest relative abundance in the assemblage (Assis *et al.*, 2022). In the Serra do Amolar, also in the Pantanal, the species was the most commonly detected mammal, with 311 independent records and an estimated rate of 5.17 records per 100 trap-nights, although this value was standardized here from data reported by the authors rather than directly presented as RAI in the original study (Bardales *et al.*, 2024).

Figure 2

Sampling stations and records of Dasyprocta azarae in the Planalto Central Environmental Protection Area, Federal District, Brazil



Source: elaborated by the authors, 2026.

Higher values were also observed in Atlantic Forest remnants, although the magnitude of the difference varied among studies. In the Floresta Nacional de São Francisco de Paula, D. azarae had 409 records, corresponding to an estimated RAI of 3.77 records per 100 camera-trap days, and was the species with the highest frequency of photo-captures among medium and large mammals (Marques; Fabián, 2018). In Turvo State Park, D. azarae was also the most photographed species, representing 26.92% of photographic records, with CPUE values ranging from 30.3 to 32.1 records per 100 trap-nights across sampling campaigns; the species was also recorded in 94% of track transects and classified as common (Kasper *et al.*, 2007). Thus, even considering methodological differences among studies, the relative abundance recorded in the APAPC was lower than most values reported for D. azarae in Pantanal and Atlantic Forest landscapes.

These comparisons should be interpreted with caution because camera-trap-based abundance indices are influenced not only by population size, but also by detectability, camera placement, habitat structure, animal behavior, camera model, sampling design, and the criteria used to define independent records (Srbek-Araujo; Chiarello, 2013; Tobler *et al.*,

2008; Wearn; Glover-Kapfer, 2017). Camera-trap rates are widely used as relative abundance indices, but they should not be interpreted as direct density estimates unless supported by more robust analytical approaches, such as capture-recapture, random encounter models, or occupancy-based approaches (Rowcliffe *et al.*, 2008; Tobler *et al.*, 2008; Wearn; Glover-Kapfer, 2017). Nevertheless, the lower RAI and the restricted spatial distribution of records in the APAPC suggest that D. azarae occurred at low relative abundance in the monitored portion of the study area.

The restricted spatial distribution of records may be related to local habitat conditions. In the present study, most independent records were concentrated in gallery forest, reinforcing the importance of forested habitats within Cerrado landscapes. This interpretation is consistent with landscape-scale evidence from the Cerrado. In the Bodoquena Plateau, Amiot *et al.* (2021) found that the occurrence of D. azarae was associated with forest cover and edge density at spatial scales between 500 and 2,000 m, especially when forest was defined using high tree-cover thresholds. Therefore, although D. azarae is not restricted to primary forest, its occurrence in savanna landscapes may depend strongly on the availability of structurally forested habitats, such as gallery forests, forest edges, and riparian vegetation.

The low relative abundance recorded in the APAPC may also reflect local anthropogenic pressures. The APAPC is a sustainable-use protected area where human occupation, agriculture, roads, domestic animals, and other land uses occur within its limits. Such pressures may affect medium-sized mammals through habitat fragmentation, hunting, disturbance, road mortality, and changes in resource availability. National assessments indicate that D. azarae is currently classified as Least Concern in Brazil, but they also recognize that the species may be locally affected by hunting and that knowledge gaps remain regarding its ecology, population status, and responses to threats (Percequillo *et al.*, 2024). Therefore, the low RAI and spatially restricted records observed in the APAPC suggest that local environmental conditions and human pressures may influence the occurrence and relative abundance of D. azarae in this Cerrado protected area.

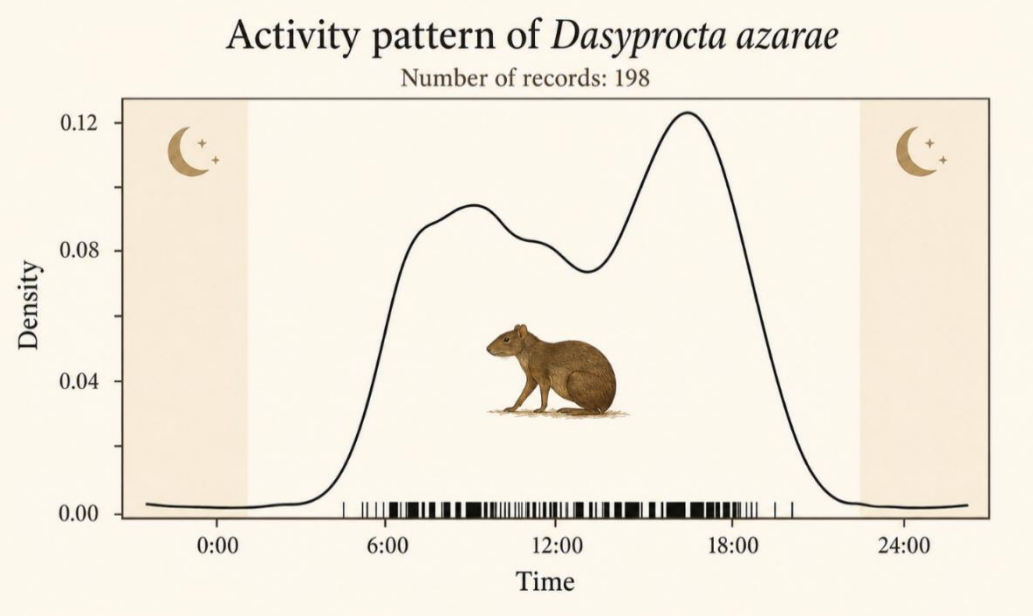
4.2 ACTIVITY PATTERN

The activity pattern of Dasyprocta azarae in the APAPC was assessed based on 198 independent records. Most detections occurred during the day, totaling 158 records (79.8%). Crepuscular activity accounted for 38 records (19.2%), whereas nocturnal activity was rare, with only two records (1.0%). Based on the classification proposed by Jiménez *et al.* (2010), D. azarae was classified as a diurnal species in the study area.

Kernel density estimates indicated a bimodal activity pattern, with two main periods of activity throughout the day. The first and broader peak occurred between 07:00 and 12:00 h, followed by a reduction around midday, especially between 13:00 and 14:00 h. A second activity peak occurred in the afternoon, between 15:00 and 18:00 h (Figure 3). Nocturnal activity was rare and represented by only two independent records, indicating that night-time activity is occasional in the APAPC population.

Figure 3

Kernel density estimates of the daily activity pattern of Dasyprocta azarae in the Planalto Central Environmental Protection Area, Federal District, Brazil



Source: elaborated by the authors, 2026.

The predominance of diurnal activity observed in the APAPC is consistent with previous studies on D. azarae in different regions and vegetation types. In an Amazon–Cerrado transition landscape, D. azarae was also classified among the predominantly diurnal species (Negrões *et al.*, 2011). In the Pantanal, the species has been reported as diurnal in both the Urucum Massif and other wetland landscapes (Cid; Oliveira-Santos; Mourão, 2015; Assis *et al.*, 2022). In southern Brazil, D. azarae was also described as predominantly or exclusively diurnal in Atlantic Forest remnants (Kasper *et al.*, 2007; Marques; Fabián, 2018).

The reduction in activity during the hottest hours of the day may reflect behavioral adjustment to thermal conditions. In the Pantanal, D. azarae adjusts its daily activity according to temperature, reducing activity during periods of greater heat exposure and concentrating activity during cooler periods of the day (Cid; Oliveira-Santos; Mourão, 2015). A similar relationship between temperature and daily activity has been reported for D. leporina

in the Atlantic Forest, where local climatic variation influenced activity schedules and behavioral plasticity (Magalhães; Srbek-Araujo, 2019). Therefore, the bimodal pattern observed in the APAPC may represent a response to daily thermal variation, with activity concentrated in the morning and late afternoon, when environmental conditions are probably less stressful.

Although D. azarae showed low relative abundance and a restricted spatial distribution in the APAPC, its daily activity pattern was similar to that reported for other populations. This suggests that local factors, such as habitat availability, disturbance, and landscape structure, may affect the species' occurrence and relative abundance more strongly than its basic daily activity rhythm. Overall, these results confirm the predominantly diurnal behavior of D. azarae and provide additional evidence of a bimodal activity pattern in a protected Cerrado area of Central Brazil.

4.3 TEMPORAL OVERLAP WITH SYMPATRIC SPECIES

After characterizing the activity pattern of Dasyprocta azarae, we evaluated its temporal overlap with sympatric mammals recorded in the APAPC that could potentially interact with the species as predators or competitors. Six species were initially considered for temporal comparison: Eira barbara, Leopardus pardalis, Puma concolor, Cuniculus paca, Hydrochoerus hydrochaeris, and Coendou longicaudatus. However, P. concolor and C. longicaudatus were excluded from the overlap analysis because of the low number of independent records. Therefore, temporal overlap analyses were conducted with E. barbara, L. pardalis, C. paca, and H. hydrochaeris.

Among the analyzed species, Eira barbara showed the highest temporal overlap with D. azarae (Dhat = 0.79). Both species were predominantly diurnal, with activity concentrated during daylight hours. Eira barbara showed higher activity during the morning and early afternoon (Figure 4A), whereas D. azarae showed a bimodal pattern, with activity peaks in the morning and late afternoon. The overlap was especially evident during the morning and afternoon periods, indicating that both species share similar activity windows in the APAPC (Figure 4A).

However, high temporal overlap should not be interpreted as direct evidence of predation or interaction. Eira barbara is an opportunistic omnivore, with a diet that may include fruits, invertebrates, small vertebrates, and carrion (Presley, 2000), and predation on agoutis has been reported occasionally (Galef Jr.; Mittermeier; Bailey, 1976). Nevertheless, temporal overlap alone indicates only similarity in activity schedules. Confirming direct

interaction between these species would require additional evidence, such as predation records, spatial co-occurrence at the same sampling stations, or behavioral observations.

In contrast, Leopardus pardalis showed low temporal overlap with D. azarae (Dhat = 0.14). The ocelot showed predominantly nocturnal and crepuscular activity, with detections concentrated after 18:00 h and before 06:00 h (Figure 4B), whereas D. azarae was mostly active during daylight hours. This temporal segregation may reduce encounter rates between the two species (Figure 4B). Although L. pardalis is a known predator of agoutis and other medium-sized mammals (Aliaga-Rossel *et al.*, 2006; Bianchi *et al.*, 2014), the low overlap observed in the APAPC suggests that temporal partitioning may reduce predation risk during most of the agouti's active period.

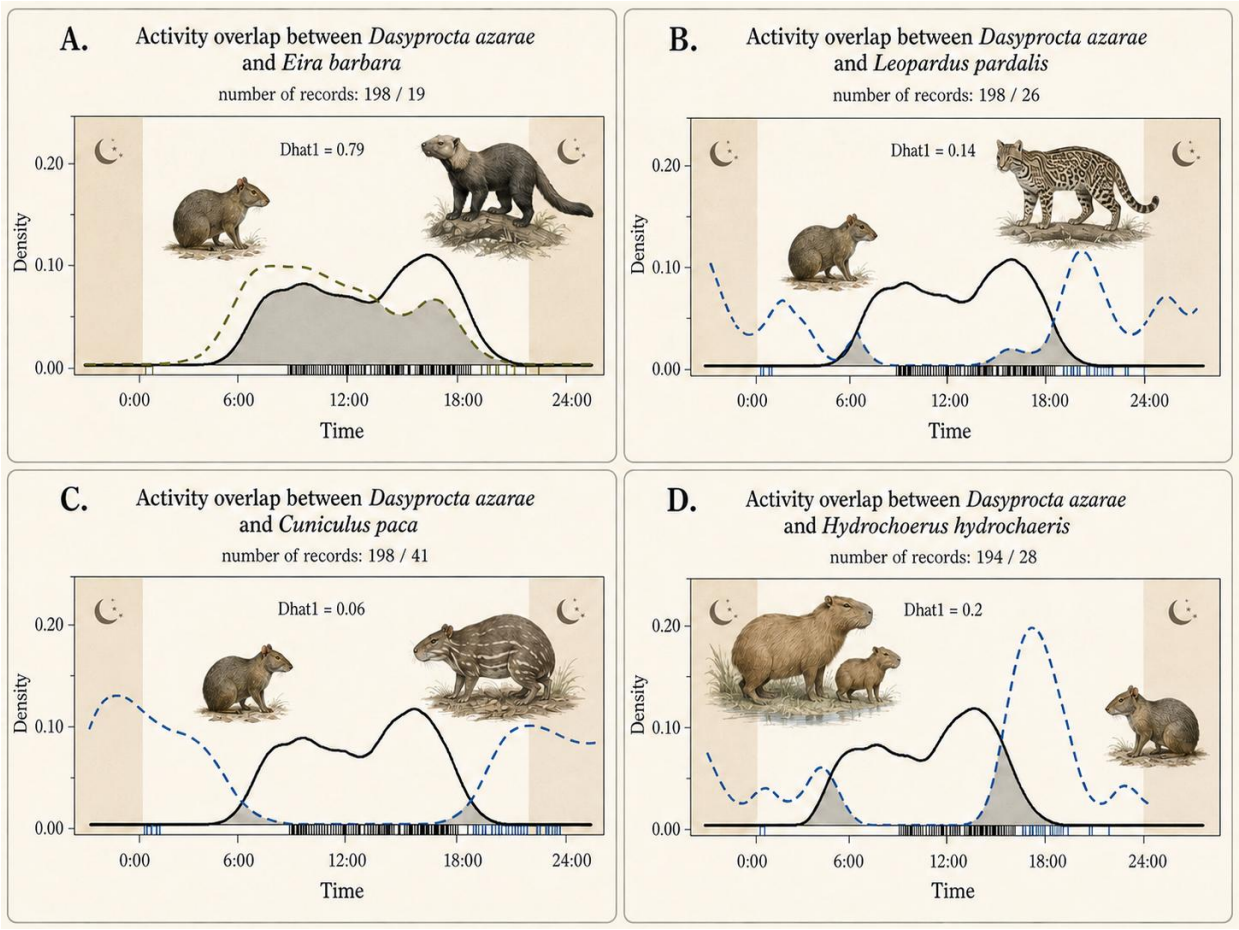
The lowest temporal overlap was observed between D. azarae and Cuniculus paca (Dhat = 0.06). While D. azarae was predominantly diurnal, C. paca showed a nocturnal pattern, with most records occurring between 18:00 h and 05:00 h (Figure 4C). This strong temporal segregation indicates that these two frugivorous-granivorous rodents use different periods of the day, even if they occur in the same landscape and may use some similar food resources (Figure 4C). Therefore, differences in activity schedules may reduce direct competition and contribute to temporal niche partitioning between these species in the APAPC.

Temporal overlap between D. azarae and Hydrochoerus hydrochaeris was also low (Dhat = 0.20). Capybaras showed predominantly nocturnal activity in the study area, with activity increasing after 18:00 h (Figure 4D), whereas D. azarae was active mainly during daylight hours. Because capybaras differ strongly from agoutis in body size, diet, habitat use, and social behavior, the low overlap observed here probably reflects distinct ecological requirements rather than direct temporal avoidance (Figure 4D).

Overall, the temporal overlap analyses indicate that D. azarae shared activity periods mainly with another diurnal species, E. barbara, while showing strong temporal segregation from nocturnal or predominantly nocturnal species such as L. pardalis, C. paca, and H. hydrochaeris. These results suggest that temporal partitioning may contribute to reducing potential encounters and interactions among sympatric mammals in the APAPC. Together with the low relative abundance, spatially restricted records, and predominantly diurnal activity pattern reported for D. azarae, these findings highlight the importance of long-term camera-trap monitoring for understanding the ecology of this species in Cerrado landscapes.

Figure 4

Temporal overlap in activity patterns between Dasyprocta azarae and sympatric mammal species recorded in the Planalto Central Environmental Protection Area (APAPC), Federal District, Brazil. Panels show overlap between D. azarae and (A) Eira barbara, (B) Leopardus pardalis, (C) Cuniculus paca, and (D) Hydrochoerus hydrochaeris. The solid black line represents the activity density of D. azarae, while the colored dashed line represents the activity density of the compared species. Shaded areas under the curves indicate temporal overlap, and light vertical bands mark nighttime periods. Tick marks along the x-axis indicate independent records. The Dhat1 values in each panel indicate the level of temporal overlap between the species. Animal illustrations are included only for visual reference and are not presented to scale



Source: elaborated by the authors, 2026.

5 CONCLUSIONS

This study examined the relative abundance, activity pattern, and temporal overlap of Dasyprocta azarae with sympatric mammals in the Planalto Central Environmental Protection Area, a protected Cerrado area in Central Brazil. Despite the extended sampling effort and long-term camera-trap survey, D. azarae showed low relative abundance and a restricted

spatial distribution, with records concentrated at only a few sampling points, mainly in gallery forest. This pattern suggests that the species is unevenly distributed within the APAPC and highlights the importance of forested habitats in Cerrado landscapes.

The activity pattern of D. azarae was predominantly diurnal and bimodal, with activity peaks in the morning and late afternoon. This pattern is consistent with previous studies on the species and indicates that, although local conditions may influence abundance and occurrence, the basic daily activity rhythm of D. azarae appears to be conserved across different regions. Temporal overlap analyses showed high overlap with the diurnal species Eira barbara, but low overlap with Leopardus pardalis, Cuniculus paca, and Hydrochoerus hydrochaeris, suggesting temporal segregation between D. azarae and predominantly nocturnal or crepuscular species.

Overall, these findings expand current knowledge of D. azarae in the Cerrado, where information on the species is still limited. Its low relative abundance, restricted spatial distribution, and association with forested habitats underscore the importance of long-term monitoring and conservation measures aimed at preserving gallery forests and maintaining habitat connectivity within the APAPC. The results also emphasize the value of camera-trap studies for improving our understanding of the ecology, behavior, and possible interactions of medium-sized mammals in protected landscapes affected by human activities.

However, these findings should be interpreted with caution because camera traps were not randomly placed, sampling design varied during the monitoring period, and formal occupancy or density models were not applied, limiting broader inferences about the entire APAPC.

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ETHICAL STATEMENT

The authors declare that they all agree with this publication and made significant contributions to the study; that there is no conflict of interest of any kind; and that all pertinent ethical and legal procedures and requirements were followed. All financial sources, when applicable, are fully and clearly stated in the acknowledgments section. A signed document has been filed in the journal archives.

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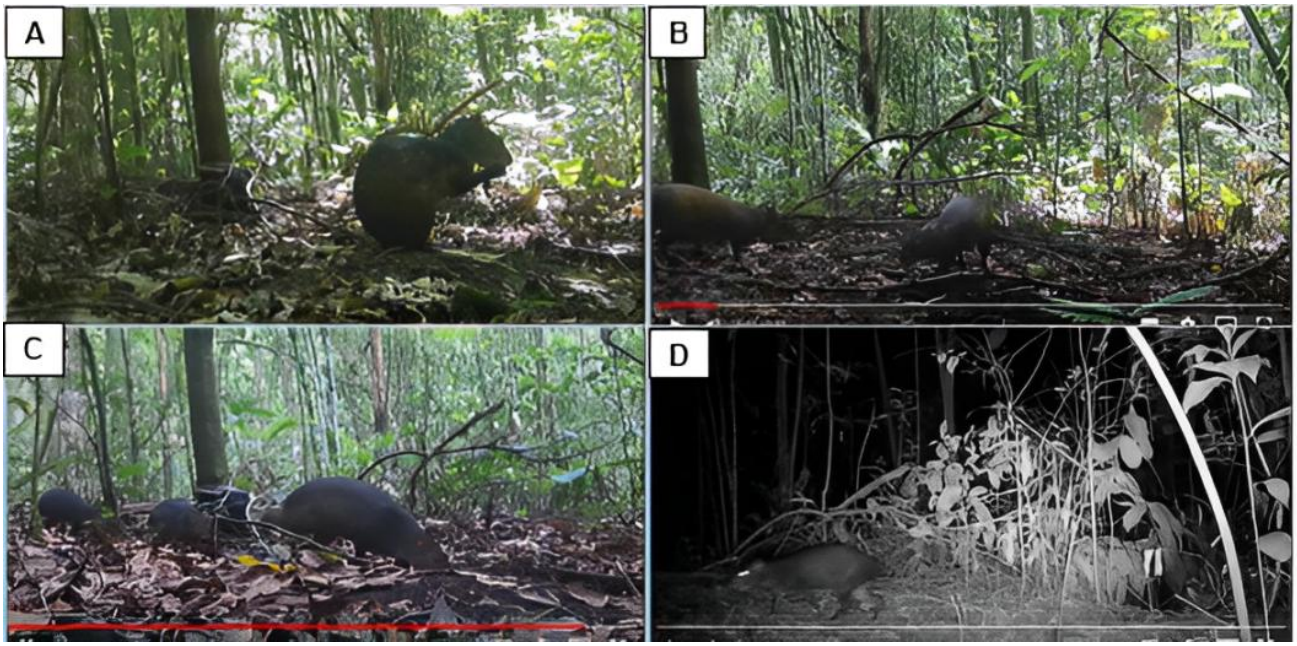
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APPENDIX A

Camera-trap records of Dasyprocta azarae in the Planalto Central Environmental Protection Area

Figure 5

Figure A1. Representative camera-trap records of Dasyprocta azarae obtained in the Planalto Central Environmental Protection Area (APAPC), Federal District, Brazil. (A) Individual feeding; (B) pair foraging; (C) adult female with two juveniles; (D) rare nocturnal record. Panel D is included to illustrate the rare nocturnal detections recorded during the monitoring program. Images are provided for illustrative purposes only



Source: aPAPC monitoring program archive, provided by Cláudia Rocha-Campos, 2024.