Terrestrial mammal community of the protected landscape valle del lunarejo: a camera trap-based study

Comunidade de mamíferos terrestres da paisagem protegida valle del lunarejo: um estudo baseado em armadilhas fotográficas

Comunidad de mamíferos terrestres del paisaje protegido valle del lunarejo: un estudio basado en cámaras trampa

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ABSTRACT
This study presents an updated inventory of the terrestrial mammal community in the Valle del Lunarejo Protected Landscape, located in northeastern Uruguay. The primary objectives were to enhance knowledge of mammal diversity and distribution in Uruguay, assess species richness, estimate the relative abundance of each identified species, and determine the activity patterns of the most abundant species through camera trap data. A total of 35 cameras were deployed, with a 1 km distance between each camera to ensure independent records, resulting in a total sampling effort of 1,877 trap nights. The results revealed the presence of 14 native and 3 exotic mammal species, with the common brown brocket (*Subulo gouazoubira*) being the most abundant native species, exhibiting predominantly diurnal activity. This study provides valuable data for the conservation and management of the protected area, and it also recorded two species of significant conservation concern: the Margay (*Leopardus wiedii*), a priority species in Uruguay, and Muñoa's Pampas cat (*Leopardus munoai*), one of the most threatened small wild cats globally, which is critically endangered in Uruguay.

Keywords: mammals, camera trapping, activity patterns, richness, relative abundance, protected landscape, critical endangered species.

RESUMO
Este estudo apresenta um inventário atualizado da comunidade de mamíferos terrestres na Paisagem Protegida do Valle del Lunarejo, localizada no nordeste do Uruguai. Os principais objetivos foram aumentar o conhecimento sobre a diversidade e a distribuição de mamíferos no Uruguai, avaliar a riqueza de espécies, estimar a abundância relativa de cada espécie identificada e determinar os padrões de atividade das espécies mais abundantes por meio de dados de armadilhas fotográficas. Um total de 35 câmeras foi instalado, com uma distância de 1 km entre cada câmera para garantir registros independentes, resultando em um esforço total de amostragem de 1.877 noites de armadilhas. Os resultados revelaram a presença de 14 espécies nativas e 3 exóticas de mamíferos, sendo que o brocket marrom comum (Subulo gouazoubira) foi a espécie nativa mais abundante, apresentando atividade predominantemente diurna. Esse estudo fornece dados valiosos para a conservação e o gerenciamento da área protegida, além de registrar duas espécies de grande

preocupação em termos de conservação: o gato-maracajá (Leopardus wiedii), uma espécie prioritária no Uruguai, e o gato-palheiro de Muñoa (Leopardus munoai), um dos pequenos felinos selvagens mais ameaçados do mundo, que está criticamente em perigo no Uruguai.

Palavras-chave: mamíferos, armadilhas fotográficas, padrões de atividade, riqueza, abundância relativa, paisagem protegida, espécies críticas ameaçadas de extinção.

RESUMEN
Este estudio presenta un inventario actualizado de la comunidad de mamíferos terrestres en el Paisaje Protegido Valle del Lunarejo, ubicado en el noreste de Uruguay. Los objetivos principales fueron mejorar el conocimiento de la diversidad y distribución de mamíferos en Uruguay, evaluar la riqueza de especies, estimar la abundancia relativa de cada especie identificada y determinar los patrones de actividad de las especies más abundantes a través de datos de cámaras trampa. Se desplegaron un total de 35 cámaras, con una distancia de 1 km entre cada cámara para garantizar registros independientes, lo que supuso un esfuerzo total de muestreo de 1.877 noches de trampa. Los resultados revelaron la presencia de 14 especies de mamíferos autóctonos y 3 exóticos, siendo la corzuela parda común (Subulo gouazoubira) la especie autóctona más abundante, con una actividad predominantemente diurna. Este estudio proporciona datos valiosos para la conservación y gestión del área protegida, y también registró dos especies de gran interés para la conservación: el margay (Leopardus wiedii), una especie prioritaria en Uruguay, y el gato de las pampas de Muñoa (Leopardus munoai), uno de los pequeños felinos silvestres más amenazados a escala mundial, que se encuentra en peligro crítico en Uruguay.

Palabras clave: mamíferos, cámaras trampa, patrones de actividad, riqueza, abundancia relativa, paisaje protegido, especies en peligro críticas.

1 INTRODUCTION

Valle del Lunarejo, a protected landscape in northeastern Uruguay, is home to a diverse array of terrestrial mammal species. Despite its ecological significance, information on the mammal communities in this region remains limited. This study aims to update the mammal inventory of the area, thereby enhancing the understanding of local biodiversity and providing crucial data for its conservation.

Camera traps have proven to be a highly effective tool for monitoring mammal populations, offering valuable insights into abundance, activity patterns, and species diversity without direct interaction with the animals (Kays et al., 2009). This method allows for the capture of a representative sample of nocturnal, diurnal, and crepuscular species (O'Brien et al., 2011).

The primary goal of this study was to expand knowledge on mammal diversity and distribution in Uruguay. The specific objectives included assessing species richness, estimating the relative abundance of identified species, and determining the activity patterns of the most abundant species.

2 STUDY AREA

Valle del Lunarejo is located in northeastern Uruguay, in the Rivera Department, near the border with Brazil. This protected landscape, covering approximately 31,500 hectares, is recognized for its biodiversity, serving as one of the country's main wildlife refuges. The area is characterized by a rich diversity of ecosystems, including subtropical forests, native shrubland, and grasslands. The region's climate is temperate, with well-defined seasons, contributing to habitat variability for various species.

This protected landscape is a key site for the conservation of endemic species and those of high ecological value, acting as a biological corridor between natural areas of Uruguay and Brazil. The vegetation is predominantly subtropical forest and remains in good conservation status due to limited human intervention. Additionally, the valley is known for the presence of vulnerable and threatened species, highlighting the importance of its protection to ensure the survival of these species.

Despite its relative protection, the area faces conservation challenges due to the expansion of agricultural frontiers and illegal activities such as poaching. Therefore, it is crucial to have updated data on the biodiversity of the area to guide effective conservation strategies and ensure the preservation of the ecosystems and species inhabiting Valle del Lunarejo.

3 MATERIALS AND METHODS

Data Collection

Mammal monitoring was conducted using camera traps, automatic devices that record the presence of animals through a motion sensor. A total of 35 cameras were placed between September 2022 and December 2024. These cameras were distributed across the study area, with a minimum distance of 1 km between them. The cameras were programmed to remain active for at least 60 days, generating 20-second videos each time motion was detected. The total sampling effort reached 1,877 trap-days.

Analysis

The data obtained from the camera traps were used to determine species richness, activity patterns, and relative abundance of species present in Valle del Lunarejo. The activity pattern analysis was performed using Oriana 4.02 software (Kovach, 2011), which allowed the classification of species based on their diurnal (8:00 a.m – 5:00 p.m), nocturnal (8:00 p.m – 4:00 a.m), and crepuscular (5:00 p.m – 8:00 p.m and 4:00 a.m – 8:00 a.m) activity.

The relative abundance of each species was calculated using the Relative Abundance Index (RAI), determined using the following formula: RAI = C / EM × 100 trap-days where C is the number of captures or filmed events, EM is the sampling effort (number of cameras multiplied by total monitoring days), and 100 trap-days is the standard unit (Monroy-Vilchis et al., 2010). To ensure that the records were independent, consecutive videos of different species or those of the same species separated by more than 24 hours were considered independent.

4 RESULTS

Species richness and Relative abundance index

A total of 1,052 mammal records were obtained over 1,877 trap-days. Of these, 14 native species and 3 exotic species were identified (Table 1) (Appendix 1).

Table 1: Species richness present in the study area, Valle del Lunarejo. (RAI) Relative abundance index.

Native species			
Species	Common name	# Records	RAI
Cerdocyon thous	Crab-eating fox	129	6,87
Conepatus chinga	Molina's hog-nosed skunk	63	3,35
Dasypus novemcinctus	Nine-banded armadillo	245	13,05
Didelphis albiventris	White-eared opossum	3	0,15
Galictis cuja	Lesser grison	5	0,26
Hydrochoerus hydrochaeris	Capybara	12	0,63
Leopardus geoffroyi	Geoffroy's cat	10	0,53
Leopardus munoai	Muñoa's Pampas Cat	1	0.05
Leopardus wiedii	Margay	32	1,7
Lycalopex gymnocercus	Pampas fox	52	2,77
Nasua nasua	South American coati	26	1,38
Procyon cancrivorus	Crab-eating raccoon	19	1,01
Subulo gouazoubira	Common brown brocket	249	13,26
Tamandua tetradactyla	Southern tamandua	6	0,31
Sphiggurus spinosus	Paraguaian hairy dwarf porcupine	1	0,05
Non-Native Species			
Species	Common name	# Records	RAI
Axis axis	Axis deer	82	4,36
Lepus europeus	European hare	10	0,53
Sus scrofa	Wild boar	107	5,7

Source: Created by the author (2025).

In the analysis of the native species with the highest presence in the study area, the top five species stood out, showing high relative abundance in the sample.

The most abundant species is the Common brown brocket (*Subulo gouazoubira*), with a total of 249 records and a relative abundance index (RAI) of 13.26. In second place is the Nine-banded armadillo (*Dasypus novemcinctus*), with 245 records and a RAI of 13.05. In third place, the Crab-eating fox (*Cerdocyon thous*) ranks third, with 129 records and a RAI of 6.87. In fourth place is

Molina's hog-nosed skunk (*Conepatus chinga*) with 63 records and a RAI of 3.35. Finally, the Pampas fox (*Lycalopex gymnocercus*) is in fifth place, with 52 records and a RAI of 2.77 (Table 1).

Together, these five species reflect a great diversity of native mammals, with the Common brown brocket and the Nine-banded armadillo leading the list in terms of abundance. The presence of the Pampas fox and the Molina's hog-nosed skunk, alongside other species such as the Crab-eating fox, highlights the importance of a varied fauna that plays a key role in maintaining the ecological balance of the area.

Activity Pattern

Of the five highlighted species, the Common brown brocket showed a predominantly diurnal activity pattern (Figure 1). Meanwhile, the Nine-banded armadillo (Figure 2), Crab-eating fox (Figure 3), Molina's hog-nosed skunk (Figure 4), and Pampas fox (Figure 5) exhibited mostly nocturnal activity. Although the Pampas fox showed a peak of activity between 6:30 and 8:00 a.m.

Figure 1: Circadian activity distribution of *Subulo gouazoubira* during the hours of the day. The blue histograms show the species' activity distribution, while the vector represents the mean (μ) along with the 99% standard deviation. Source: Created by the author (2025).

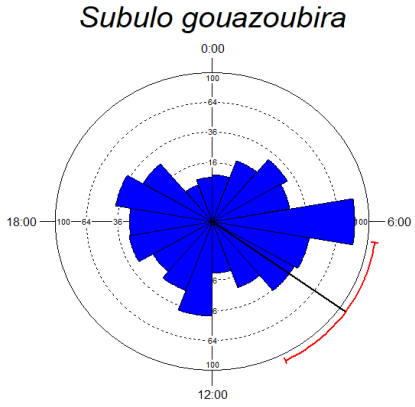


Figure 2: Circadian activity distribution of *Dasypus novemcinctus* during the hours of the day. The blue histograms show the species' activity distribution, while the vector represents the mean (μ) along with the 99% standard deviation. Source: Created by the author (2025).

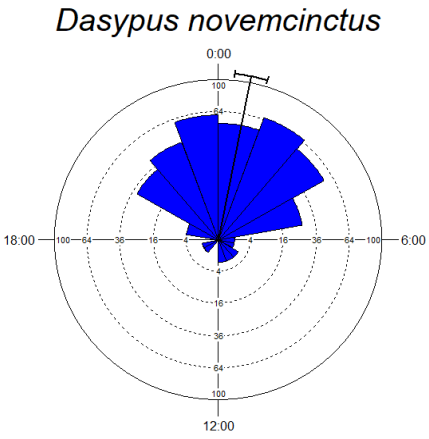


Figure 3: Circadian activity distribution of *Cerdocyon thous* during the hours of the day. The blue histograms show the species' activity distribution, while the vector represents the mean (μ) along with the 99% standard deviation. Source: Created by the author (2025).

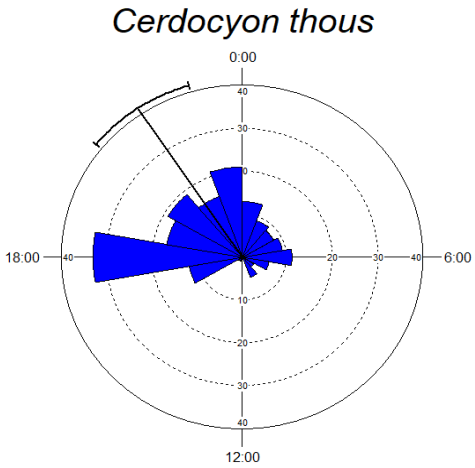


Figure 4: Circadian activity distribution of *Conepatus chinga* during the hours of the day. The blue histograms show the species' activity distribution, while the vector represents the mean (μ) along with the 99% standard deviation. Source: Created by the author (2025).

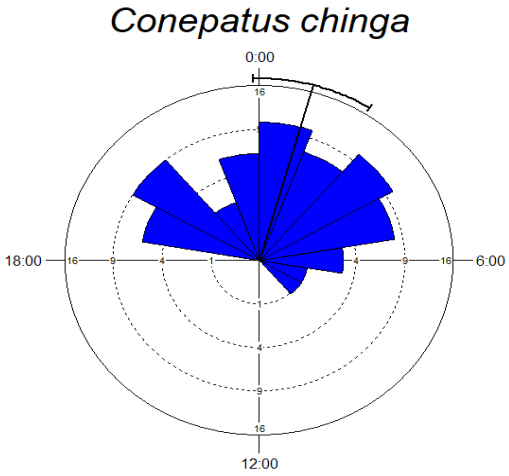
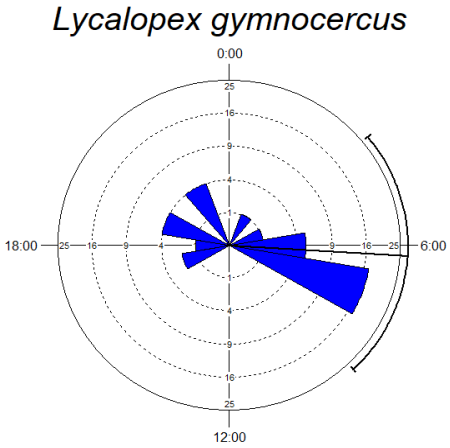


Figure 5: Circadian activity distribution of *Lycalopex gymnocercus* during the hours of the day. The blue histograms show the species' activity distribution, while the vector represents the mean (μ) along with the 99% standard deviation. Source: Created by the author (2025).



5 DISCUSSION

This study provides a valuable update on the mammal community of the Valle del Lunarejo, highlighting both the species diversity and the activity patterns that characterize the community. The methodology employed, based on camera trapping, proved to be an effective tool for obtaining ecological data on mammals in protected areas. The results obtained can serve as a foundation for future conservation and management strategies in the area, considering the importance of native species, such as the Margay, and the need to protect endangered species, such as the Muñoa's Pampas Cat. Furthermore, the presence of exotic species underscores the urgency of effective management to mitigate potential adverse ecological impacts.

It is worth noting that the Margay (*Leopardus wiedii*), a priority species for conservation in Uruguay, was recorded for the first time in this region, representing a significant finding for local biodiversity (Cravino, A et al., 2017). The presence of this species in the Valle del Lunarejo is highly relevant, as there were no previous records of it in this part of the country. This discovery reinforces the importance of conserving the area as a refuge for species of high ecological value.

Another particularly important record was that of the Muñoa's Pampas Cat (*Leopardus munoai*), a critically endangered species and one of the most threatened small wild cats in the world. This record is especially significant because it represents the first live record in the country in over a decade, highlighting the value of Valle del Lunarejo as a refuge for species at severe risk of extinction (Sunquist & Sunquist, 2002).

However, the presence of invasive species, such as the Axis Deer (*Axis axis*) and Wild Boar (*Sus scrofa*), calls attention to the need for ongoing management efforts to mitigate their impact on native biodiversity.

6 CONCLUSION

The findings of this study provide critical insights that will guide future conservation strategies, highlighting the urgent need to preserve the ecological integrity of the Valle del Lunarejo. Ensuring the survival of its unique and endangered species, alongside promoting sustainable management practices, is essential in response to escalating anthropogenic pressures. The conservation of this protected landscape is not only vital for safeguarding biodiversity in Uruguay but also for maintaining regional ecological connectivity with natural habitats in neighboring Brazil.

In conclusion, this study underscores the significance of Valle del Lunarejo as a crucial area for both the conservation of Uruguay’s biodiversity and the preservation of regional ecological corridors with Brazil. Continued and adaptive management strategies are essential to protect this

distinctive and threatened wildlife community, ensuring the long-term sustainability of this valuable protected area.

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APPENDIX

Appendix 1: List of Recorded Species and Their Description

Below is a list of the medium and large terrestrial mammal species recorded in Valle del Lunarejo with their respective conservation statuses in Uruguay, according to the National System of Protected Areas.

Native Species

- *Cerdocyon thous*
  Conservation status: Stable, not threatened.
- *Conepatus chinga*
  Conservation status: Stable, not threatened.
- *Dasypus novemcinctus*
  Conservation status: Stable, not threatened.
- *Didelphis albiventris*
  Conservation status: Common, not threatened.
- *Galictis cuja*
  Conservation status: Stable, not threatened.
- *Hydrochoerus hydrochaeris*
  Conservation status: Least concern, stable.
- *Leopardus geoffroyi*
  Conservation status: Least concern, population declining.
- *Leopardus munoai*
  Conservation status: Critically endangered, very rare presence.
- *Leopardus wiedii*
  Conservation status: Near threatened, population priority for conservation.
- *Lycalopex gymnocercus*
  Conservation status: Stable, not threatened.
- *Nasua nasua*
  Conservation status: Stable, not threatened.
- *Procyon cancrivorus*
  Conservation status: Stable, not threatened.

- *Subulo gouazoubira*
  Conservation status: Not threatened, stable population.

- *Tamandua tetradactyla*
  Conservation status: Near threatened.

- *Sphiggurus spinosus*
  Conservation status: Not threatened, stable population.

Exotic Species

- *Axis axis*
  Conservation status: Invasive species.

- *Lepus europeus*
  Conservation status: Invasive species.

- *Sus scrofa*
  Conservation status: Invasive species.

This summary includes the conservation status of each species based on their situation in Uruguay, according to the National System of Protected Areas.