

Activity patterns of the Andean cottontail *Sylvilagus andinus* (Lagomorpha: Leporidae) in a peri-urban context in a ravine in Puenbo, Quito valley, Ecuador

Elias Viteri-Basso^{1,2*} , Rebecca Zug² 

¹Universidad San Francisco de Quito USFQ, Colegio de Ciencias Biológicas y Ambientales, Instituto de Biodiversidad Tropical IBIOTROP, Laboratorio de Zoología Terrestre, Quito 170901, Ecuador.

²Universidad San Francisco de Quito USFQ, Colegio de Ciencias Biológicas y Ambientales, Laboratorio de Carnívoros, Quito 170901, Ecuador.

*Corresponding author: eliasviteri@gmail.com

Patrones de actividad del conejo andino *Sylvilagus andinus* (Lagomorpha: Leporidae) en un contexto periurbano en una quebrada de Puenbo, en el valle de Quito, Ecuador

Abstract

The urban ravines in Quito, Ecuador, harbor the last remnant vegetation of the city but face increasing pressure from urbanization and introduced predators. We analyzed the daily activity patterns of the Andean cottontail (*Sylvilagus andinus*) in a ravine of the Chiche River (Puenbo, Quito) using camera-traps at night between February and September 2025, and after 304 trapping nights, a total of 176 rabbit records were obtained. Cottontails were mainly nocturnal, with peak activity between 2:00 and 3:00am, and showed a significant seasonal shift, with activity concentrated in the early evening (6:30-7:30pm) during the rainy season and extending later during the night (2:00-4:00am) in the dry season. Temporal overlap with introduced predators such as dogs and cats was moderate but our data is most likely not representative, as it is based on few events (n=5). Our findings suggest that *S. andinus* varies from its main temporal activity, responding to seasonal and possibly anthropogenic factors in these urban ravines. This study establishes a baseline for future research on native mammals living in urbanization processes in Andean cities such as Quito.

Keywords: Andean Cottontail, Urban ecology, Activity patterns, Camera trapping, Quito, Seasonality, Introduced predators, Ecuador, Temporal overlap.

Resumen

Las quebradas urbanas de Quito, Ecuador, albergan la última vegetación remanente de la ciudad, pero enfrentan una presión creciente por la urbanización y depredadores introducidos. En este estudio analizamos los patrones de actividad diaria del conejo andino (*Sylvilagus andinus*) en una quebrada del río Chiche (Puenbo, Quito) mediante cámaras trampa entre febrero y septiembre del 2025, después de 304 trampas/noche. Se obtuvieron 176 registros de conejos andinos, especie que demostró tener una actividad



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principalmente nocturna, con un pico general de actividad entre las 02:00 y 03:00, y mostraron un cambio estacional significativo: su actividad se concentró en las primeras horas de la noche (18:30-19:30) durante la temporada lluviosa y se extendió hacia horas tardías en la noche (02:00-04:00) durante la temporada seca. El solapamiento temporal con depredadores introducidos como perros y gatos fue moderado, pero probablemente no representativo al estar basado en pocos eventos captados (n=5). Nuestros hallazgos sugieren que *S. andinus* varía su actividad temporal principal en respuesta a factores estacionales y posiblemente antropogénicos en estas quebradas urbanas. Este estudio establece una línea base para futuras investigaciones sobre mamíferos nativos en lugares con procesos de urbanización en ciudades andinas como Quito.

Palabras clave: Conejo andino, Ecología urbana, Patrones de actividad, Cámaras trampa, Quito, Estacionalidad, Depredadores introducidos, Ecuador, Solapamiento temporal.

INTRODUCTION

Quito, the capital city of Ecuador, is a growing city surrounded by steep ravines and valleys that contain some of the last native vegetation in the area, mainly due to the difficulty in settling and living in them. [1, 2]. These are mainly seasonally dry ecosystems, dominated by xeric shrubs and sparse forests, characterized by distinct dry and wet seasons that provide habitat to various and unique species of birds, mammals, reptiles and amphibians [3]. Although most of these ravines are classified as protected, under the city's metropolitan ordinance [4], they are constantly threatened from growing urbanization, water and land pollution, and introduced species such as feral and stray cats and dogs [5]. Since the 1980s, a major increase in urbanization and a decrease in traditional agriculture practices have profoundly impacted the natural habitats of the valleys, leaving native vegetation restricted to ravines and river canyons [6].

Human influence is known to alter the abundance and activity patterns of animals, especially mammals, because of reduced habitat, introduced species, and increased human-wildlife conflict [7, 8, 9, 10]. In the high Andes of Ecuador, the presence of dogs and cats is known to affect the abundance, presence, and activity patterns of some mammals [11]. However, most studies focus on non-urban areas. In the Metropolitan District of Quito (MDQ), few studies have focused on the specific effects of urbanization on wild vertebrates; most research has focused only on the presence and impact of dogs and cats [5, 11].

The Andean cottontail or Andean tapeti *Sylvilagus andinus*, is a rabbit that inhabits the highlands and Andean páramos of Ecuador and Colombia, and was recently documented in Peru [12]. It is one of the approximately 12 to 15 species of *Sylvilagus* found throughout the Americas, and was considered conspecific with *S. brasiliensis* until 2019 when *S. andinus* was formerly recognized as a distinct species [13]. This species is an important herbivore, consuming a variety of plants (principally Poaceae) [14], and serves as a prey species for predators such as Andean fox *Lycalopex culpaeus* [15, 16], long-tailed weasel *Mustela frenata* [14] and raptor species such as Great Horned Owl *Bubo virginianus*



[17, 18]. As is true with most other *Sylvilagus* rabbits, they are consistently crepuscular, most active at dawn and dusk [14, 19, 20, 21].

In this study, we gathered camera trap records of Andean cottontail from a ravine in Puenbo, Quito, Ecuador, to describe their daily activity patterns in this peri-urban context, taking into account seasonality and as compared to stray cats and dogs.

MATERIALS AND METHODS

We collected data using two iZeeker iG200 © camera traps placed on the outer rim of a ravine above the Chiche River, in Puenbo, Quito, Ecuador (00°09'02.5"S 78°23'24.9"W), approximately 10 km northeast from Quito's urban center to the southwest and near to 4.5 km southwest from the Quito airport (Fig. 1). This was a steep ravine, with a dry ecosystem dominated by native plants, such as century plants (*Agave cordillerensis*), carob trees (*Acacia macracantha*), cactus (*Opuntia soederstromiana*), and bromeliads (*Tillandsia* sp.).

Camera traps were placed 30m apart (linearly), with one 20m lower than the other one, in different vegetation gradients (more grasses and less shrubs). Camera traps were checked every two months to replace batteries and exchange memory cards. They completed a total of 304 camera trap nights, from February to September 2025.

Camera trap data was organized and processed using the Timelapse software (Saul Greenberg, University of Calgary) [22], where pictures were identified and organized by species and metadata was extracted for later analysis. We analyzed the daily activity patterns of Andean cottontails using R Studio [23], and the packages "lubridate" and "overlap" to calculate overlaps in activity and generate overlap plots using kernel density estimates for individual events [24, 25]. Time stamps were converted to decimal hours and then transformed into radians ($0-2\pi$) to allow circular statistical analysis. We quantified temporal overlap using overlap coefficient (Δ^*), (with values ranging from 0- no overlap to 1- complete overlap) [26], and bootstrapped 95% confidence intervals based on 1000 resamples to quantify uncertainty [27, 28].

Seasonal differences in activity distributions (rainy: February–May vs. dry: June–September) were tested using Watson's two-sample test of homogeneity, while uniformity of activity was evaluated with the Rayleigh test [29]. These periods were chosen for comparison based on the seasonal climate of Quito, with a dry season (June to September) and a rainy season (October to May) [30]. Comparisons with records from introduced predators (domestic dogs and cats) were performed using the same approach, although results were interpreted cautiously due to small sample size ($n=5$). Individual events were defined as groups of consecutive records of the same species at the same station within 60 minutes [31, 32].

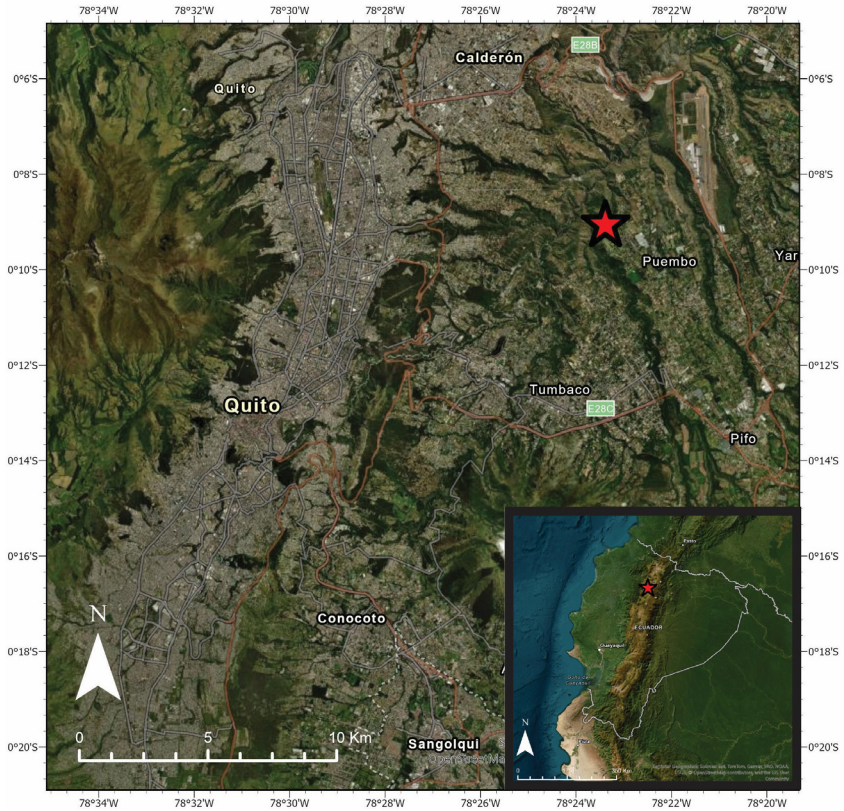


FIGURE 1. Map showing the study area (red star) where camera trap data was collected in Puenbo, Quito, Ecuador, and its position in relation to the country.

RESULTS

Over a total of 304 camera trap nights we recorded 176 individual events of Andean cottontails (*Sylvilagus andinus*) (Fig. 2A) and five individual events of dogs (n=1) and cats (n=4). Andean cottontails showed main periods of activity from 6:00pm to 6:00am, with a small peak at 7:00pm and a small drop in activity from 8:00pm to 9:00pm. Activity reached its highest peak from 2:00 to 3:00am (Fig. 2B). Temporal overlap between cottontails and introduced predators (Fig. 2C) was moderate ($\Delta_1 = 0.519$), and Watson's two-sample test showed a significant difference in activity distributions ($U^2 = 0.536$, $p < 0.001$). Comparisons between seasons (rainy: February-May, dry: June-September) revealed high overlap in rabbit activity patterns ($\Delta_4 = 0.812$, 95% CI = 0.639–0.893) (Fig. 2D), however Watson's two-sample test indicated a significant change in activity between both seasons ($U^2 = 0.205$, $0.01 < p < 0.05$).



The activity period of Andean cottontails was non-random, shown by the Rayleigh test ($Z = 0.661, p < 0.001$), with both the rainy season ($Z = 0.577, p < 0.001$) and the dry season ($Z = 0.706, p < 0.001$) showing significant deviations from uniformity. In contrast, the few records of domestic dogs and cats did not differ significantly from a random distribution ($Z = 0.229, p = 0.355$).

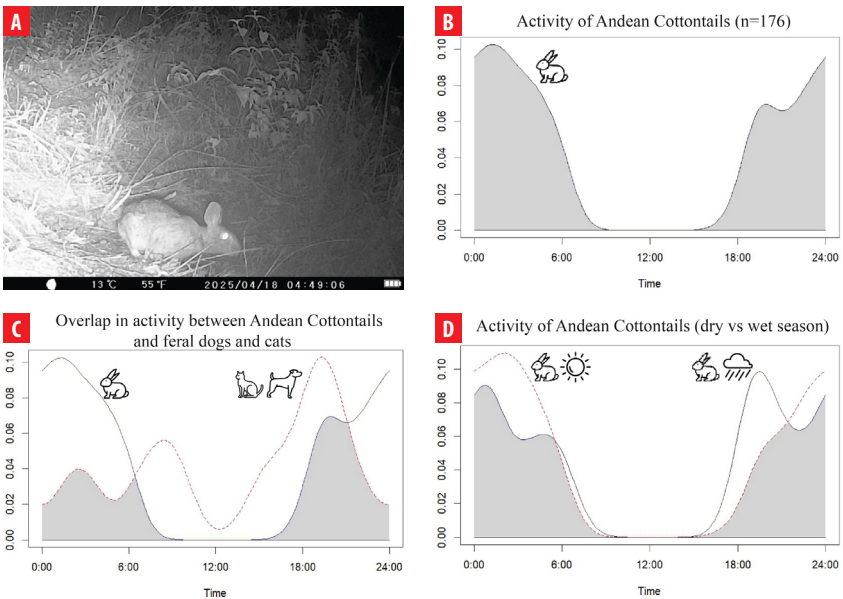


FIGURE 2. **A** Andean cottontail *Sylvilagus andinus* documented by a camera trap in Puenbo, Quito, Ecuador. **B** Daily activity patterns of Andean cottontails, showing nocturnal activity. **C** Overlap in activity patterns between Andean cottontails (solid blue line) and introduced predators, dogs and cats (dotted red line). **D** Activity pattern shift in Andean cottontails between wet months (February- May, solid blue line), and dry months (June-September, dotted red line). Gray in the figures indicates the overlap in activity.

DISCUSSION

The crepuscular-nocturnal activity period (primarily active during twilight and nighttime hours) for Andean cottontails in this study was partly consistent with other *Sylvilagus* species which typically show mostly crepuscular activity (active at dawn and dusk) [14, 19, 20, 21, 33, 34, 35, 36]. However, cottontails in our study showed peak activity throughout the night, coinciding with only some species of cottontails studied [33, 37], and deviating from the predominantly crepuscular activity described for most cottontail species. It is important to consider that because rabbits are territorial most of the activity described could have been from few individuals that forage in the area in front of the cameras. We could identify at least 4 different individuals based on size, sex, and other characteristics such as ear and tail shape; recognizing one juvenile (small size), two males (had testes but differed in size), and one female (adult- no testes). Their nocturnal activity may reflect adaptations to dry habitat as observed in the desertic Audubon's cottontail rabbits *Sylvilagus audobonii* [33]. Alternatively, it may be associated with light intensity, resource



availability, increased visibility to predators, or avoidance of human activity as seen in the nocturnal behavior reported for *Sylvilagus minensis* in Brazil [37].

The significant changes in seasonal activity patterns may be influenced by various factors. Quito experiences two seasons based on precipitation- a dry season (June to September) and a rainy season (October to May), when the region receives at least 75% of the total annual precipitation [30]. Cottontails showed a shift in activity between these periods, peaking at 2:00am-4:00am during the dry season and shifting toward a peak in the early hours of the night at 6:00pm-8:00pm during the rainy season, decreasing its overall night activity. These results show a similar seasonal shift in activity as reported for *S. minensis* in Brazil, with greater nocturnal activity during the dry season and a concentration of activity in the early night during the wet season, suggesting that changes in resource availability and photoperiods associated with seasonality may drive temporal changes in their activity [37]. Other changes attributed to seasonality occur primarily in locations with four marked seasons, where ecosystem structure and daylight hours change significantly across months [35, 36], which is not the case for Quito. We hypothesize that these changes may have to do with weather patterns- with colder, wet nights in the rainy season and warmer, dryer nights in the dry season- that may influence foraging behaviors through changes in resource and light availability, when cloud accumulation during the wet season causes it to get darker earlier than during the dry season.

When looking at overlapping activity between cottontails and introduced predators (cats and dogs), we acknowledge that the low number of records of predators is a strong limitation for our results, possibly a product of the small area surveyed. This does not rule out that there may be more cats that could heavily impact rabbit populations. However, we did observe a trend in dog and cat activity towards the day. Some feral dog populations are known to be more active during the day, and their presence impacts mammalian communities negatively (lower abundances, reduced activity) [11, 38], while feral cats also seem to show activity during the day, but also at night depending on the location [38, 39, 40, 41]. Only one cat was observed so we cannot account for any trend or effect on the rabbit population or activity observed. However, the presence of this cat and multiple dogs may account for the small dip in overall rabbit activity just after dusk, when the cat was recorded by the camera trap.

CONCLUSIONS

Our observations highlight the need for understanding how urban ecosystems influence the behavior of wildlife. Our findings indicate that Andean cottontails in Quito's periurban ravines exhibit predominantly nocturnal activity with seasonally shifting peaks, likely influenced by environmental conditions, where limited predator detections highlight the need for further study to clarify the drivers of these temporal patterns. If seasonality has an influence on the activity of these important herbivores that promote plant diversity and act as key prey [14, 15, 16], what might be the impacts of prolonged drought and irregular rain patterns in Quito and the Andes driven by climate change [42, 43, 44]? Further studies regarding introduced predators, seasonal changes within and across years, and the effects of urbanization such as light and sound pollution should be explored. Comparing



the activity patterns between these understudied urban cottontails and those that live in native, remote habitats in Ecuador may be key to understanding the impact of urbanization on this rabbit species. We highlight the need for understanding vertebrate communities in cities like Quito and its peri-urban edge ravines, with the impacts that rapid and unplanned growth may have had on these groups.

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AUTHORS' CONTRIBUTIONS

Conceptualization: Elias Viteri-Basso (EVB); Data curation: EVB; Formal analysis: EVB; Funding acquisition: EVB; Investigation: EVB; Methodology: EVB; Resources: EVB; Visualization: EVB, Rebecca Zug (RZ); Writing-original draft: EVB; Writing-review and editing: EVB and RZ.

DATA AVAILABILITY STATEMENT

Data are available upon reasonable request to the corresponding author (in exceptional cases).

DECLARATION OF GENERATIVE AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

For this work, the authors did not use any generative or AI-assisted technology.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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