

Living on the city: Records of night monkeys (*Aotus spp.*) in urban and peri-urban forests of Colombia

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Urbanization has transformed natural habitats by concentrating human populations in urban areas, with important consequences for biodiversity. In Colombia, several mammals, including primates, have occupied urban areas in different regions of the country. The objective of this study is to compile information on night monkeys (*Aotus spp.*) in urban and peri-urban forests in Colombia, based on field records and literature review. We compiled our own and literature records of night monkeys from urban and peri-urban forests in Colombia between 2018 and 2024. We categorized these records by type and grouped them by night monkey species, geographic location, type of population center (departmental capital city, municipality, corregimiento and vereda), and proximity to urban infrastructure. 36 localities were identified (23 new and 13 from the literature), distributed in 11 departments, ranging from the capital city to the veredas, where night monkeys have been recorded in urban and peri-urban areas. The most abundant species was *A. lemurinus*, and we report the first urban and peri-urban records of *A. brumbacki*, *A. griseimembra* and *A. vociferans*. About 33 % of the records of night monkeys in urban and peri-urban forests were found in capital cities with a population of more than 100000 people. Additionally, we report the use of 3 artificial sleeping sites in urban and peri-urban forests by *A. brumbacki*, *A. griseimembra* and *A. vociferans* groups. Records were also found in educational institutions such as schools and universities, suggesting the possibility of establishing long-term studies with these night monkeys as flagship species. The monitoring of these primates in urban and peri-urban environments is crucial for their conservation and to guide public policies towards sustainable development, especially in the management of urban threats such as electrocution, which remains a significant problem.

La urbanización ha transformado los hábitats naturales al concentrar poblaciones humanas en áreas urbanas, con importantes consecuencias para la biodiversidad. En Colombia, varios mamíferos, incluyendo primates, han ocupado áreas urbanas en diferentes regiones del país. El objetivo de este estudio es recopilar información sobre monos nocturnos (*Aotus spp.*) presentes en bosques urbanos y periurbanos de Colombia, con base en registros de campo y revisión bibliográfica. Recopilamos entre 2018 y 2024 registros propios y de literatura de monos nocturnos de bosques urbanos y periurbanos en Colombia. Categorizamos estos registros según su tipo y los agrupamos de acuerdo con la especie de mono nocturno, la ubicación geográfica, el tipo de centro poblado (ciudad capital departamental, municipio, corregimiento y vereda) y la proximidad a infraestructuras urbanas. Se identificaron 36 localidades (23 nuevas y 13 de la literatura), distribuidas en 11 departamentos y ubicadas desde ciudades capitales hasta veredas donde se han registrado monos nocturnos en zonas urbanas y periurbanas. La especie más abundante fue *A. lemurinus*, y reportamos los primeros registros urbanos y periurbanos de *A. brumbacki*, *A. griseimembra* y *A. vociferans*. Aproximadamente el 33 % de los registros de monos nocturnos en bosques urbanos y periurbanos se encontraron en ciudades capitales con poblaciones superiores a 100000 habitantes. Adicionalmente, reportamos el uso de tres dormideros artificiales en bosques urbanos y periurbanos por grupos de *A. brumbacki*, *A. griseimembra* y *A. vociferans*. Se encontraron registros en instituciones educativas como escuelas y universidades, lo que sugiere la posibilidad de establecer estudios a largo plazo con estos monos nocturnos como especies banderas. El monitoreo de estos primates en entornos urbanos y periurbanos es crucial para su conservación y para orientar políticas públicas hacia el desarrollo sostenible, especialmente en la gestión de amenazas urbanas como la electrocución, que sigue siendo un problema importante.

Keywords: Andean region; Aotidae; educational institutions; electrocution; Primates; sleeping sites; urbanization.

Introduction

The percentage of natural cover worldwide has been transformed by anthropogenic activities by more than 75 % ([IPCC 2019](#)). In Colombia, although it is estimated that about 52 % of the territory is covered by natural forest, there is an annual deforestation rate of 0.62 % ([Armenteras et al. 2013](#); [IDEAM 2020](#)). Especially in this country, the greatest transformation of forests has occurred as a result of the expansion of crops and the agricultural frontier, the establishment of pastures for livestock and the construction of infrastructures and urbanizations ([Etter and Wyngaarden 2000](#); [Etter et al. 2008](#)).

Urbanization is the process through which dispersed human populations living in small rural settlements grow and concentrate in dense urban cores. This occurs alongside industrial and agricultural development necessary to provide services, resulting in alteration of the natural environment ([McIntyre 2011](#); [Hussain and Imitiyaz 2018](#)). The changes in land use and intervention of natural land cover often result in a mixture of human infrastructures and forest remnants within urban areas or in surrounding areas ([Wear 2013](#); [Salbitano et al. 2016](#)). In general, urban and peri-urban forests present alterations in their structure and composition due to the constant pressures of urbanization, as not all species are able to adapt to these changes ([Wear 2013](#)).

Colombia is recognized as the sixth country with the highest diversity of mammals due to its strategic location in the tropics, where different geographical regions converge ([Ramírez-Chaves et al. 2016](#)). This diversity is also represented in urban and peri-urban forests, where numerous mammal species among different orders have been recorded, such as Chiroptera ([Balles-teros and Racero-Casarrubia 2012](#); [Rosero-Tamaruel et al. 2023](#)), Didelphimorphia ([Barrera-Niño and Sánchez 2014](#); [Guimarães et al. 2023](#)), Carnivora ([González-Maya et al. 2017](#); [Sánchez-Londoño et al. 2023](#)) and Primates ([Poveda and Sánchez-Palomino 2004](#); [Soto-Calderón et al. 2016](#); [Montilla et al. 2018, 2020](#); [Bustamante-Manrique et al. 2021](#); [Grajales-Suaza et al. 2021](#)). Among the primates recorded in urban and peri-urban areas of Colombia are night monkeys of the species *A. lemurinus*, which is characterized, as well as the other species of the genus, by its ability to adapt to different forest types ([Montilla et al. 2018, 2020](#); [Bustamante-Manrique et al. 2021](#); [Grajales-Suaza et al. 2021](#)). Although night monkeys inhabit a variety of forest environments, most species in Colombia are threatened due to loss of habitat for urbanization, agricultural activities, illegal trade as pets, and biomedical research purposes ([Maldonado et al. 2023](#); [Shanee et al. 2023a](#)).

Records of night monkeys in urban and peri-urban areas provide opportunities for implementation of conservation tools in nearby veredas, corregimientos, municipalities, and capital cities where these charismatic species can serve

as flagship species to promote the conservation of entire communities of flora and fauna. In this context, the aim of this study is to provide new records and compile historical data on the presence of some species of the genus *Aotus* like *A. brumbacki*, *A. griseimembra*, *A. lemurinus*, and *A. vociferans* in urban and peri-urban forests in Colombia. Additionally, we recorded the use of artificial sleeping sites by groups of *A. brumbacki*, *A. griseimembra* and *A. vociferans* in peri-urban areas.

Materials and methods

We compiled records of night monkeys between 2018 and 2024 in urban and peri-urban forests from several research and conservation projects involving these primates in Colombia. Furthermore, we reviewed published scientific literature for records of night monkeys in urban and peri-urban forests. For each record obtained we determined the following aspects: the species of night monkey recorded, exact geographic location (department, municipality, locality, coordinates and altitude), date of observation, type of nearby population center (departmental capital city, municipality, corregimiento, or vereda), and source and type of record (either daytime observation in sleeping site, nocturnal observation when night monkeys are active, or electrocuted individuals). Moreover, for the records directly obtained by us, we calculated (using satellite images) the minimum distance between the observed night monkeys and the buildings that are part of the population center.

We included as urban and peri-urban records any within a minimum distance of 105 m, which corresponds to the 3.5 ha radius of the average home range reported for different groups of night monkeys in Colombia (between 1.1 and 8 ha; [Guzmán et al. 2016](#); [Bustamante-Manrique et al. 2021](#); [Montilla et al. 2021a](#)). Based on the categorization by [Balk et al. \(2018\)](#), we defined as urban records all those where the area of 3.5 ha had a coverage of at least 50 % of buildings that are part of the population center, and as peri-urbans, those where the coverage of buildings was less than 50 %. The measurements of the area and the estimations of the percentage of coverage were made with the circular ruler tool of Google Earth Pro.

Considering the scarce morphological differentiation among night monkeys' species, the identification of each record was based mainly on the geographic distribution, following the proposals of [Henao-Díaz et al. \(2020\)](#) and [Shanee et al. \(2023b\)](#). Consequently, all sightings in the Orinoquía region were attributed to *A. brumbacki*, those in the Magdalena Medio Valley to *A. griseimembra*, those in the Amazonia to *A. vociferans*, and those in the Andes to *A. lemurinus*. The record located in northern Antioquia, which could be on the boundary between the distribution of *A. lemurinus* and *A. griseimembra*, was assigned to *A. lemurinus* according to the potential distribution map by [Henao-Díaz et al. \(2020\)](#).

Results

In total, we documented the presence of night monkeys in urban and peri-urban areas of 36 different localities in Colombia. Of these, 23 are new records, while 13 are records previously published in scientific literature. Sightings of night monkeys in urban and peri-urban forests are distributed in 20 municipalities belonging to 11 departments, at altitudes ranging from 93 to 2,258 masl (Table 1; Figure 1). Most of these records occurred in municipalities (16 records), followed by capital cities (12 records), corregimientos (4 records) and veredas (4 records). 12 of the records are located in urban areas, while 24 correspond to peri-urban forests. The most frequently species of night monkey in urban and peri-urban forests was *A. lemurinus*, with 26 records, followed by *A. brumbacki* and *A. griseimembra* with 4 records each, and *A. vociferans* with 2 records. Most of the records were obtained by nocturnal observation (19 records), followed by daytime observations at sleeping sites (9 records), and those documented after electrocution events (6 records). On one occasion, the presence of night monkeys in peri-urban forests was recorded through museum specimens and interviews. From the new records, we identified distances between 7 and 84 meters (mean: 28.73; \pm 21.90) between night monkey observations and buildings that are part of population centers (see Table 1).

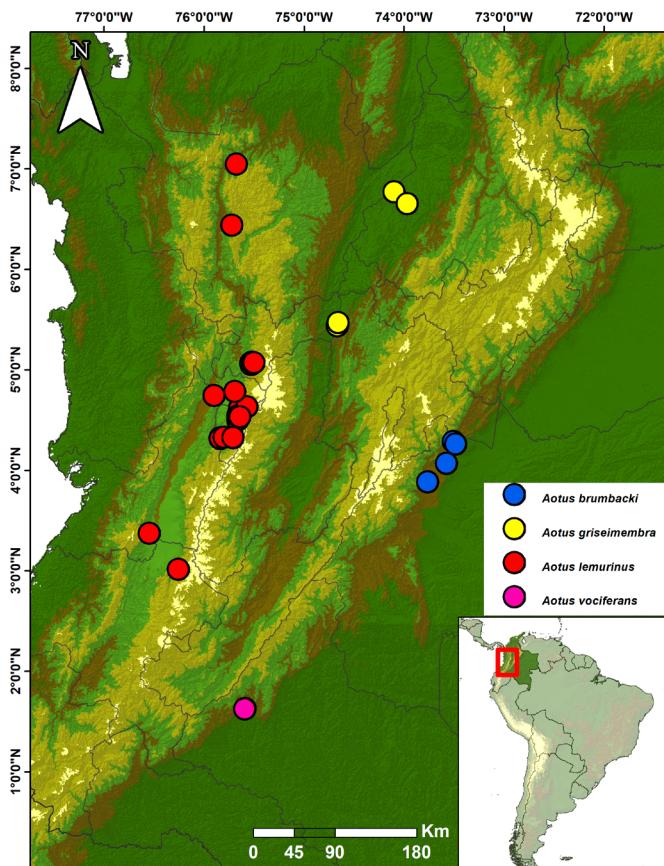


Figure 1. Geographic location of night monkey (*Aotus* spp.) records in urban and peri-urban forests in Colombia.

In three of the localities where we recorded the presence of night monkeys through diurnal observations, we identified artificial sleeping sites used by social groups of *A. brumbacki*, *A. griseimembra* and *A. vociferans*. In the first locality, situated in the municipality of Guamal, Meta, we recorded a group of four individuals of *A. brumbacki* using as a sleeping site a small "house" built with wooden planks and a galvanized roof. This structure was specifically constructed by the sector's inhabitants to serve as a sleeping site for the night monkeys (Figure 2). At the second locality, in Puerto Parra, Santander, we recorded a group of *A. griseimembra* consisting of three individuals sleeping during the day on a corrugated zinc sheet rolled up from the base of the tree (Figure 3). This zinc sheet was unintentionally placed by the owner of a nearby house on the tree where the night monkeys were sleeping, and after a few days they began to use it as a sleeping site. In the third locality, situated in Florencia, Caquetá, we sighted a group of three *A. vociferans* individuals using a hole in a metal structure that serves as a door jamb of a country restaurant as a sleeping site. According to the owners of the restaurant, when they began construction of the door, they noticed that the main beam was being inhabited by night monkeys and instead of chasing them away, they decided to allow them to stay there (Figure 4).

Discussion

We provide new records of the presence of *A. lemurinus* and the first records of *A. brumbacki*, *A. griseimembra* and *A. vociferans* in urban and peri-urban areas of Colombia, through diurnal, nocturnal and by means of observations of electrocuted individuals. Other records of night monkeys in urban and peri-urban areas have been made in the state of Rondônia, Brazil for individuals of *A. nigriceps*, which have also been observed consuming exotic flowers in urban trees (Chaves et al. 2021). In Colombia, other studies have documented the presence of different primate species in urban and peri-urban forests. Among them are: *Alouatta seniculus* (Cañate et al. 2019), *Saguinus leucopus* (Poveda and Sánchez-Palomino 2004; Soto-Calderón et al. 2016), *Saimiri cassiquiarensis* (Alfonso 2017; Buitrago and Ceballos 2018), *Sapajus apella* (Alfonso 2017) and *Plecturocebus ornatus* (Alfonso 2017; Ortiz-Moreno et al. 2022).

About 72 % of the records of night monkeys in urban and peri-urban forests in Colombia correspond to the species *A. lemurinus*, which may be related to the distribution of this species in the Andean region of the country. This species is present on both slopes of the 3 Andean Mountain ranges (Henao-Díaz et al. 2020; Shanee et al. 2023b), where most urban settlements in Colombia are concentrated and where about 70 % of the national population resides (Defler 2010; Armenteras et al. 2011). This region is also characterized by one of the highest rates of landscape transformation in Colombia, as it estimated 80 % of the natural vegetation having been modified (Etter et al. 2008). The Andean region of Colombia also includes the Middle Mag-

Table 1. Records of night monkey's species (*Aotus* spp.) in urban and peri-urban forests in Colombia. Species (Sp), Department (Dept), Municipality (Mun), Locality (Loc), Latitude, longitude (Lat/Lon), Altitude (Alt), Urban or peri-urban (U/P), Population center (PopC), Distance from population center (m) (DistPop (m)), Source, type of record and date (Source/Record/Date).

Sp	Dept	Mun	Loc	Lat/Lon	Alt	U/P	PopC	DistPop (m)	Source/Record/Date
<i>A. brumbacki</i>	Meta	Cumaral	El Paraíso pools	4.2692, -73.4942	417	P	Municipality	12	Daytime observation (sleeping site)*, during September and November of 2021
			Inspección de Guacavía	4.2908, -73.5197	459	P	Corregimiento	21	Daytime observation (sleeping site)*, March 3, 2022
		Guamal	Vereda Santa Bárbara	3.8896, -73.7721	536	U	Vereda	7	Daytime observation (sleeping site)*, June 4, 2022
		Villavicencio	Universidad de Los Llanos	4.0751, -73.5845	400	P	Vereda	-	Alfonso 2017.
<i>A. griseimembra</i>	Caldas	La Dorada	Las Delicias neighborhood	5.4450, -74.6697	177	U	Municipality	11	Registered by interview
	Cundinamarca	Puerto Salgar	Comando Aéreo de Combate"	5.4774, -74.6624	174	U	Municipality	11	Daytime observation (sleeping site)*, September 2, 2023
	Santander	Puerto Parra	Vereda Agualinda	6.6614 -73.9712	143	P	Vereda	23	Daytime observation (sleeping site)*, May 11, 2023
			Vereda Bocas del Carare	6.7806 -74.1012	93	U	Vereda	33	Daytime observation (sleeping site)*, August 18, 2024
<i>A. lemurinus</i>	Antioquia	San Jerónimo	Los Cedros residential unit	7.0557, -75.6739	747	P	Municipality	40	Daytime observation (sleeping site)*, May 13, 2023
		Toledo	Corregimiento of El Valle de Toledo - Biomax service station	6.4476, -75.7181	484	P	Corregimiento	12	Electrocuted individual*, October 3, 2023
	Caldas	Manizales	Campohermoso neighborhood	5.0833, -75.5166	1900	P	Capital city	-	Bustamante-Manrique <i>et al.</i> 2021.
			La Francia neighborhood	5.0725, -75.5302	2007	U	Capital city	-	Nocturnal observation
			Nogales neighborhood	5.0590, -75.5235	2029	U	Capital city	-	Montilla <i>et al.</i> 2020.
			Northwest of Manizales	5.0833, -75.5166	2100	P	Capital city	-	Electrocuted individual
				5.0833, -75.5166	2100	P	Capital city	-	Montilla <i>et al.</i> 2020.
				5.07916, -75.4986	2258	P	Capital city	-	Electrocuted individual
				5.07916, -75.4986	2258	P	Capital city	-	Nocturnal observation
				5.07916, -75.4986	2258	P	Capital city	-	Museum specimens
	Cauca	Toribío	Corregimiento of Tacueyó - La Guaca Hostel	3.0206, -76.2447	1703	P	Corregimiento	10	MHN-UCa1503, UCa504, UCa3288 cited in Marín 2023
Quindío	Armenia	Museo del Oro Quimbaya	4.5705, -75.6483	1615	P	Capital city	-	Nocturnal observation*, February 14, 2024	
			Parque de la Vida	4.5469, -75.657	1517	P	Capital city	63	Montilla <i>et al.</i> 2018.
			Sena Agropecuario	4.5712, -75.6415	1590	P	Capital city	-	Nocturnal observation
	Calarcá	La Bombonera synthetic fields	4.5390, -75.6367	1557	P	Municipality	57	Montilla <i>et al.</i> 2021b.	
		Colegio San José	4.5081, -75.6587	1473	P	Municipality	-	Nocturnal observation	
	Circasia	Colegio Libre	4.6199, -75.6423	1746	P	Municipality	-	Montilla <i>et al.</i> 2021b.	
			Las Casuarinas avenue	4.3349 -75.7050	1666	U	Municipality	-	Nocturnal observation
	Pijao		La Playita neighborhood	4.3310 -75.7051	1635	U	Municipality	-	Montilla <i>et al.</i> 2020.
			Laureano Gómez neighborhood	4.3325, -75.7065	1660	U	Municipality	7	Electrocuted individual
			Corregimiento of Barragán	4.3371, -75.792	1106	U	Corregimiento	8	Nocturnal observation*, November 12, 2022
			Alto de la cruz Viewpoint	4.6401, -75.566	2015	P	Municipality	57	Nocturnal observation*, March 15, 2018
Risaralda	Pereira	Universidad Tecnológica de Pereira	4.7928, -75.6885	1459	U	Capital city	48	Nocturnal observation*, January 13, 2024	
	Valle del Cauca		La Ciudadela neighborhood	4.3346, -75.8203	1145	P	Municipality	33	Daytime observation (sleeping site)*, May 8, 2018
			Bellavista Lakes	4.3317, -75.8321	1167	P	Municipality	84	Nocturnal observation*, April 5, 2023
			Las Carmelitas neighborhood	4.3251, -75.8342	1191	P	Municipality	54	Nocturnal observation*, January 27, 2023
			La Isabela neighborhood	4.3243, -75.8322	1194	P	Municipality	23	Nocturnal observation*, February 20, 2024
	Cali	Universidad del Valle	3.3772, -76.5344	981	U	Capital city	17	Nocturnal observation*, November 23, 2023	
		Cartago	Ortíz creek	4.7521, -75.8945	945	P	Municipality	-	Grajales-Suaza <i>et al.</i> 2021.
<i>A. vociferans</i>	Caquetá	Florencia	La Florida neighborhood	1.6293, -75.5864	400	P	Capital city	14	Nocturnal observation*, June 20, 2020
			La Ceiba restaurant	1.6342, -75.5841	475	P	Capital city	16	Nocturnal observation*, June 22, 2022

*New records



Figure 2. Artificial sleeping site used by a group of our individuals of *A. brumbacki* recorded in urban forests of Guamal, Meta.

dalen Valley, where four more records of night monkeys in urban and peri-urban forests were presented, specifically for the species *A. griseimembra*. As for *A. brumbacki*, this was another species with a high number of records with a total of four occurrences, all of them restricted to the foot-hill subregion of the Orinoquía. This specific area concentrates approximately 80 % of the entire population of the Orinoquía region, where the largest regional infrastructure is located ([Jiménez 2012](#); [Devia and Piñeros 2021](#)).

Nearly 33 % of night monkey records in urban and peri-urban forests in Colombia occurred in capital cities categorized as special (population over 500,001 inhabitants), as in the case of Cali, as well as in first category cities (with a population over 100,001 inhabitants), such as Armenia, Manizales, Pereira and Villavicencio. Of these cities, Armenia, Manizales y Pereira are the capitals of the three departments that make up the Eje Cafetero, a subregion with a landscape that has approximately 19.8 % crop cover and 25.3 % forest cover, according to [Otero et al. \(2005\)](#). This landscape is structurally complex, composed of agroforestry and silvopastoral systems, which allows the presence of native fauna and acts as biological corridors, contributing to some extent to the maintenance of environmental services ([Weibull et al. 2003](#); [Pérez-Torres et al. 2009](#)). In the Eje Cafetero region, we have recorded night monkeys of the species *A. lemurinus* and *A. griseimembra* in urban and peri-urban forests. Although these species are listed in the vulnerable to extinction (VU) category of the IUCN (International Union for Conservation of Nature), they are considered to be adapted to transformed landscapes ([Defler 2010](#); [Montilla et al. 2018](#); [Link et al. 2021a, 2021b](#)).

The record of *A. lemurinus* from the Universidad del Valle in the urban area of Cali should be interpreted with caution due to uncertainty as to whether this population is introduced and arose from individuals released or escaped after biomedical research, or whether it represents a native population. In 1979, the Colombian National Health Institute (INS) established a colony of night monkeys in Bogotá

for biomedical research purposes, from 57 specimens captured in San Marcos, Sucre (Caribbean region; [Umaña et al. 1984](#)). Subsequently, some individuals from this colony were transferred to several research centers, including the Instituto de Inmunología of the Universidad del Valle, in Cali, where several investigations on the development of vaccines against malaria were carried out using these primates as a model ([López et al. 1997](#); [Jordan-Villegas et al. 2005](#); [Herrera-Valencia 2002, 2005](#)). Particularly of the individuals at the Universidad del Valle, there are no clear reports on their final fate, and it has been suggested that some individuals may have escaped or been released, establishing social groups on the university campus. On the other hand, it is also possible that the night monkeys at the Universidad del Valle correspond to native individuals, since wild night monkeys have also been reported in the vicinity of the city of Cali, both to the south in the rural area of the corregimiento of Pance and to the north in the corregimiento of Dapa in the municipality of Yumbo ([Hirche et al. 2017](#); [Wolovich et al. 2023](#)). Further genetic analyses are necessary to confirm the provenance of the night monkeys at the Universidad del Valle by comparing their genetic data to those of native populations present in rural areas of Cali and Valle del Cauca.

Two of the new records of night monkeys in peri-urban forests involved individuals of *A. lemurinus* that were victims of electrocution events. Additional incidents include one reported by [Castaño et al. \(2010\)](#) in a forest at the middle Cauca River basin, as well as two others reported by [Saa-vedra-Rodríguez et al. \(2013\)](#) in a rural area at the department of Valle del Cauca, and 10 more reported by [Montilla et al. \(2020\)](#) along the Cordillera Central. All of these records underestimate the true magnitude of the serious threat posed by power grids to night monkeys, especially for populations inhabiting urban and peri-urban forests. According to [Kumar and Kumar \(2015\)](#) and [Slade \(2016\)](#), it is estimated that only 31 to 36 % of electrocutions of primates are reported.



Figure 3. Artificial sleeping site used by a group of three individuals of *A. griseimembra* recorded in peri-urban forests of Puerto Parra, Santander.

In addition, six of the records of night monkeys in urban and peri-urban areas have been documented in educational institutions, such as the Colegio Libre in Circasia, Quindío, the Colegio San José in Calarcá, Quindío, the Gimnasio Militar FAC "TC. Flavio Angulo Piedrahita" in Puerto Salgar, Cundinamarca, the Universidad de Los Llanos in Villavicencio, Meta, the Universidad del Valle in Cali, Valle del Cauca, and the Universidad Tecnológica de Pereira in Pereira, Risaralda. These circumstances open the possibility for these institutions to advance in research processes through continuous long-term monitoring of night monkeys, which could lead to implementation of conservation strategies where these primates are considered as flagship species for these institutions.

Regarding the use of artificial sleeping sites by groups of *A. brumbacki*, *A. griseimembra* and *A. vociferans* in urban and peri-urban forests, several studies have focused on describing the behavior of sleeping sites used by night monkey species. However, none of these studies report these primates sleeping site in human-made structures (Aquino and Encarnación 1986; García and Braza 1993; Puertas et al. 1995; Savagian and Fernandez-Duque 2017; González-Hernández et al. 2020; Montilla et al. 2024). In the case of *Saguinus bicolor*, another Neotropical primate species, tests were conducted with artificial sleeping sites with different characteristics, and the individuals showed a preference for wooden boxes that provided them with greater security from predators (Ahsmann 2022). Due to the constant noise pressures and the presence of people near the urban and peri-urban forests where night monkeys live, it is possible that they perceive sleeping sites as safe places within environments altered by human activity.

Recording night monkeys in urban and peri-urban areas is key for research and opens opportunities for conservation. It is crucial to further understand the adaptive capacity of primates to these environments, the viability of these populations, and the effects of habitat degradation, loss, and fragmentation in these particular landscapes. Such knowledge will allow us to articulate compelling arguments for the inclusion of these charismatic and threatened species (in the case of *A. brumbacki*, *A. griseimembra* and *A. lemurinus*) habitat in public policies related to land use. Moreover, this will be useful to consider them in effective ecological development plans for municipalities, as well as monitoring and conservation of protected areas (e.g. water protection zone). Furthermore, this is also an opportunity to promote the development of these localities through specialized tourism (ecotourism and scientific tourism), conservation education, and the use of these species as a flagship for cultural activities. However, urban landscapes still pose threats to these primates that need to be managed in collaboration with local institutions and environmental authorities, such as run overs, electrocution, and illegal trade.

New records of night monkeys in urban and peri-urban areas of Colombia reveal the adaptability of these species to environments modified by human activities. These findings highlight the importance of conducting research to understand how human presence and landscape changes affect the distribution and behavior of wildlife. In addition, the identification of threats such as electrocution by power grids underscores the need to implement effective conservation measures to protect these species in urbanized environments. The possible perception by night monkeys of

artificial sleeping sites as safe havens also raises questions about the interaction between wildlife and human infrastructure in these environments. Ultimately, these records are important as a basis for future research and conservation actions specific to primates near urban areas.

Acknowledgments

Soy Conservación foundation carries out conservation activities for *A. lemurinus* thanks to the contribution of market strategies led by Café Tandil and Inga | Hecho para la biodiversidad in Caicedonia, Valle del Cauca, as well as for

A. griseimembra in the Magdalena Medio. We would like to express our gratitude to the community of El Manantial, Fernando Hoyos Cardozo, Major Alfonso, and Jhosman Julian Parra for their support and fundamental contributions in data collection in Florencia, Caquetá. Special thanks also go to Felipe Osorio Meluk and Diana Carina Vallejo, members of the Cumalar Biodiversa Collective, for making visible the importance of *A. brumbacki* in Cumalar, Meta, and for their efforts in conserving the species in the region. Additionally, we want to acknowledge Dr. Xyomara Carretero-Pinzón for her support in registering sleeping sites and monitoring



Figure 4. Artificial sleeping site used by a group of three individuals of *A. vociferans* recorded in peri-urban forests of Florencia, Caquetá.

them. We are also grateful to the Colombian Aerospace Force, Comando Aereo de Combate No1, Gimnasio Militar FAC "TC. Flavio Angulo Piedrahita", and CT. Andrea Carolina Gómez Ruge, Rectora Gimnasio Militar FAC "TC. Flavio Angulo Piedrahita", for their support in the research and conservation process, particularly for the project "conociendo a: ¡Los monos nocturnos caribeños!", presented at the ÁGORA 2023 aerospace week. Finally, we extend our gratitude to the Therios study group of the Universidad del Valle for their help in data collection in Cali, Valle del Cauca.

Literature cited

- AHSMANN, J., ET AL. 2022. Testing artificial nestbox designs for in-situ conservation of tamarins. *Applied Animal Behaviour Science* 256:105768.
- ALFONSO, C. A. 2017. Mamíferos terrestres de un campus universitario en el Piedemonte Llanero colombiano y evaluación de cebos para su captura Villavicencio, Colombia. Undergraduate thesis, Universidad de Los Llanos, Villavicencio, Colombia.
- AQUINO, R., AND F. ENCARNACIÓN. 1986. Characteristics and use of sleeping sites in *Aotus* (Cebidae: Primates) in the Amazon lowlands of Peru. *American Journal of Primatology* 11:319–331.
- ARMENTERAS, D., ET AL. 2013. National and regional determinants of tropical deforestation in Colombia. *Regional Environmental Change* 13:1181–1193.
- ARMENTERAS, D., ET AL. 2011. Understanding deforestation in montane and lowland forests of the Colombian Andes. *Regional Environmental Change* 11:693–705.
- BALK, D., ET AL. 2018. Understanding urbanization: A study of census and satellite-derived urban classes in the United States, 1990–2010. *PloS one* 13:e0208487.
- BALLESTEROS, C. J., AND J. RACERO-CASARRUBIA. 2012. Murciélagos del área urbana en la ciudad de Montería, Córdoba - Colombia. *Revista MVZ Córdoba* 17:3193–3199.
- BARRERA-NIÑO, V., AND F. SÁNCHEZ. 2014. Foraging of *Didelphis pernigra* (Mammalia: Didelphidae) in a suburban area in the Sabana of Bogotá, Colombia. *Therya* 5:289–302.
- BUITRAGO, D. C., AND L. A. CEBALLOS. 2018. Estrategia para la Conservación de Primates Diurnos en el Área Urbana Consolidada de Villavicencio con Base en su Distribución y Conflictos Villavicencio, Colombia. Undergraduate thesis, Universidad de los Llanos, Villavicencio, Colombia.
- BUSTAMANTE-MANRIQUE, S., ET AL. 2021. Activity budget, home range and diet of the Colombian night monkey (*Aotus lemurinus*) in peri-urban forest fragments. *Primates* 62:529–536.
- CAÑATE, A. S., ET AL. 2019. Monitoreo de colonias de mono aullador rojo (*Alouatta seniculus*) en la antigua PTAR de Valledupar. Área Andina. Bogotá D.C., Colombia.
- CASTAÑO, J. H., RAMÍREZ, D. C., AND J. E. BOTERO. 2010. Ecología del mono nocturno andino (*Aotus lemurinus*) en fragmentos de bosque subandinos de Colombia. Pp. 69–90, in *Primatología en Colombia: Avances al principio del milenio* (Pereira-Bengoa, V. et al., eds.). Fundación Universitaria San Martín, Bogotá D.C., Colombia.
- CHAVES, J. V., ET AL. 2021. Observations on the diet of *Aotus nigriceps* (Primates: Cebidae) in an urban and peri-urban area in Rondônia state, Brazil. *Mammalogy Notes* 7:270–270.
- DEFLER, T. R. 2010. Historia natural de los primates colombianos. Universidad Nacional de Colombia-Conservación Internacional Colombia. Bogotá D. C., Colombia.
- DEVIA, C. Y., AND R. PIÑEROS. 2021. Dinámica territorial del extractivismo agrícola y petrolero a comienzos del siglo XXI en el departamento del Meta, Colombia. *Perspectiva Geográfica* 26:37–62.
- ETTER, A., AND W. VAN WYNGAARDEN. 2000. Patterns of landscape transformation in Colombia, with emphasis in the Andean region. *Ambio* 29:432–439.
- ETTER, A., MCALPINE, C., AND H. POSSINGHAM. 2008. Historical patterns and drivers of landscape change in Colombia since 1500: a regionalized spatial approach. *Annals of the American Association of Geographers* 98:2–23.
- GARCÍA, J. E., AND F. BRAZA. 1993. Sleeping sites and lodge trees of the night monkey (*Aotus azarae*) in Bolivia. *International Journal of Primatology* 14:467–477.
- GONZÁLEZ-HERNÁNDEZ, P. A., ET AL. 2020. Uso de dormideros de un grupo de *Aotus zonalis* en Pajonal, Coclé, República de Panamá. *Mesoamérica* 24:7–21.
- GONZÁLEZ-MAYA, J. F., ET AL. 2017. First confirmed record of the Striped Hog-nosed Skunk *Conepatus semistriatus* from peri-urban Bogotá, Colombia. *Small Carnivore Conservation* 55:91–96.
- GRAJALES-SUAZA, E., ET AL. 2021. New record and ecological notes on the andean night monkey (*Aotus lemurinus* L. geoffroy, 1846) in a peri-urban area of the municipality of Cartago, Valle Del Cauca, Colombia. *Neotropical Primates* 27: 46–48.
- GUIMARÃES, E., ET AL. 2023. Urban biodiversity: Cuterebriasis in free-ranging Robinson's mouse opossum (*Marmosa robinsoni*) in the suburbs of Barranquilla, Colombia. *International Journal of Parasitology* 2:183–88.
- GUZMÁN, A., ET AL. 2016. Agroecosystems and primate conservation: Shade coffee as potential habitat for the conservation of Andean night monkeys in the northern Andes. *Agriculture, Ecosystems & Environment* 215:57–67.
- HENAO DIAZ, F., ET AL. 2020. Atlas de la biodiversidad de Colombia - Primates. Asociación Primatólogica Colombiana – Instituto Alexander von Humboldt. Bogotá D. C., Colombia.
- HERRERA-VALENCIA, S., ET AL. 2002. *Aotus* monkeys: their great value for anti-malaria vaccines and drug testing. *International Journal of Parasitology* 32:1625–1635.
- HERRERA-VALENCIA, S. 2005. La malaria: estrategias actuales para el desarrollo de una vacuna efectiva. *Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales* 29: 535–547.
- HIRCHE, A., ET AL. 2017. Population density of *Aotus cf. lemurinus* (Primates: Aotidae) in a Subandean forest patch on the eastern slopes of the western Andes, Region of Dapa, Yumbo, Valle del Cauca, Colombia. *Primate Conservation* 31:1–7.
- HUSSAIN, M., AND I. IMITIYAZ. 2018. Urbanization concepts, dimensions and factors. *International Journal of Recent Scientific Research* 9:23513–23523.
- INSTITUTO DE HIDROLOGÍA, METEOROLOGÍA Y ESTUDIOS AMBIENTALES. 2020. Coberturas nacionales. IDEAM.
- INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE. 2019. Climate Change and Land: an IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems. IPCC.

- JIMÉNEZ, M. 2012. Capitalist valorization of Colombian Orinoco. Territorial division of labour and integration in the transnational accumulative process. *Ciencia Política* 7:150–180.
- JORDAN-VILLEGAS, A., ET AL. 2005. *Aotus lemurinus griseimembra* monkeys: a suitable model for *Plasmodium vivax* sporozoite infection. *American Journal of Tropical Medicine and Hygiene* 73:10–15.
- KUMAR, V., AND V. KUMAR. 2015. Seasonal electrocution fatalities in free-range rhesus macaques (*Macaca mulatta*) of Shivalik hills area in northern India. *Journal of Medical Primatology* 44:137–142.
- LINK, A., DE LA TORRE, S., AND P. MOSCOSO. 2021a. *Aotus lemurinus*. In: IUCN 2021. The IUCN Red List of Threatened Species. Version 2021 2021. www.iucnredlist.org. Accessed on 28 January 2024.
- LINK, A., URBANI, B., AND R. A. MITTERMEIER. 2021b. *Aotus griseimembra*. In: IUCN 2021. The IUCN Red List of Threatened Species. Version 2021 2021. www.iucnredlist.org. Accessed on 28 January 2024.
- LÓPEZ, J. A., ET AL. 1997. Synthetic polypeptides corresponding to the non-repeat regions from the circumsporozoite protein of *Plasmodium falciparum*: recognition by human T-cells and immunogenicity in owl monkeys. *Annals of Tropical Medicine and Parasitology* 91:253–265.
- MALDONADO, A. M., ET AL. 2023. Conservation status of the Nancy Ma's owl monkey (*Aotus nancymaae*, Hershkovitz, 1983) on the Colombian-Peruvian Amazon border. Pp. 623–647, in Owl Monkeys: Biology, Adaptive Radiation, and Behavioral Ecology of the Only Nocturnal Primate in the Americas (Fernandez-Duque, E., ed.). Springer International Publishing, New York, U.S.A.
- MARÍN, A. 2023. Mamíferos de bosques urbanos y periurbanos andinos del municipio de Manizales, Andes Centrales de Colombia Manizales, Colombia. Undergraduate thesis, Universidad de Caldas, Manizales, Colombia.
- MCINTYRE, N. E. 2011. Urban ecology: Definitions and goals. Pp. 7–16, in The Routledge handbook on urban ecology (Douglas, I., et al., eds.). Taylor and Francis Group, London. U.K.
- MONTILLA, S. O., CEPEDA-DUQUE, J. C., AND S. BUSTAMANTE-MANRIQUE. 2018. Distribución del mono nocturno andino *Aotus lemurinus* en el departamento del Quindío, Colombia. *Mammalogy Notes* 4:6–10.
- MONTILLA, S. O., ET AL. 2020. Eventos de electrocución de *Aotus lemurinus* (Primates: Aotidae) en los Andes Centrales de Colombia. *Mammalogy Notes* 6:1–7.
- MONTILLA, S. O., ET AL. 2021a. Activity patterns, diet and home range of night monkeys (*Aotus griseimembra* and *Aotus lemurinus*) in tropical lowland and mountain forests of central Colombia. *International Journal of Primatology* 42:130–153.
- MONTILLA, S. O., SÁNCHEZ-ALZATE, L. J., AND H. MANTILLA-MELUK. 2021b. Características Generales del mono nocturno andino. Pp. 17–33, in Plan de Manejo para la Conservación, Protección y Manejo Sostenible de las Poblaciones del Mono Nocturno Andino (*Aotus lemurinus*) en el Departamento del Quindío (Sánchez-Alzate, L. J., et al., eds.). Corporación Autónoma Regional del Quindío (CRQ)-Universidad del Quindío, Armenia, Colombia.
- MONTILLA, S. O., ET AL. 2024. Sleeping site sharing between *Aotus griseimembra* (Mammalia, Primates) and *Coendou quichua* (Mammalia, Rodentia) in a lowland inter-Andean valley in Colombia. *Neotropical Biology and Conservation* 19:393–404.
- ORTIZ-MORENO, M. L., ET AL. 2022. Presence of an endangered endemic primate in an ever-changing landscape in the eastern plains of Colombia. *Acta Biológica Colombiana* 27:269–281.
- OTERO, J., ET AL. 2005. Las Cercas Vivas: Oportunidades de Uso y Conservación de Biodiversidad. Instituto de Investigación de Recursos Biológicos Alexander von Humboldt. Bogotá D. C., Colombia.
- PÉREZ-TORRES, J., SÁNCHEZ-LALINDE, C., AND N. CORTÉS-DELGADO. 2009. Murciélagos asociados a sistemas naturales y transformados en la ecorregión del eje cafetero. Pp. 157–167, in Valoración de la biodiversidad en la Ecorregión del Eje Cafetero (Rodríguez, J. M., et al., eds.). Centro de Investigaciones y Estudios en Biodiversidad y Recursos Genéticos, Pereira, Colombia.
- POVEDA, K., AND P. SÁNCHEZ-PALOMINO. 2004. Habitat use by the white-footed tamarin, *Saguinus leucopus*: a comparison between a forest-dwelling group and an urban group in Mariquita, Colombia. *Neotropical Primates* 12:6–9.
- PUERTAS, P. E., AQUINO, R., AND F. ENCARNACION. 1995. Sharing of sleeping sites between *Aotus vociferans* with other mammals in the Peruvian Amazon. *Primates* 36:281–287.
- RAMÍREZ-CHAVES, H. E., SUÁREZ-CASTRO, A. F., AND F. GONZÁLEZ-MAYA. 2016. Cambios recientes a la lista de los mamíferos de Colombia. *Mammalogy Notes* 3:1–9.
- ROSERO-TARAMUEL, J. L., ET AL. 2023. Urban and peri-urban bats (Mammalia: Chiroptera) in Manizales, Colombia: exploring a conservation area in sub-Andean and Andean ecosystems. *Mammalia* 87:545–556.
- SAAVEDRA-RODRÍGUEZ, C. A., LIZCANO, Á., AND J. D. CORRALES. 2013. Incidentes de fauna silvestre en líneas de energía en zona rural del Valle del Cauca, Colombia. *Biodiversidad Neotropical* 3:85–89.
- SALBITANO, F., ET AL. 2016. Guidelines on Urban and Peri-urban forestry. Food and Agriculture Organization of the Nations United (FAO), Washington D. C., U.S.A.
- SÁNCHEZ-LONDOÑO, J. D., BOTERO-CANOLA, S., AND H. F. LÓPEZ-ARÉVALO. 2023. Diversidad de carnívoros (Carnivora) en un paisaje periurbano en los Andes Centrales de Colombia. *Mastozoología Neotropical* 30:e0824.
- Savagian, A., and E. Fernandez-Duque. 2017. Do predators and thermoregulation influence choice of sleeping sites and sleeping behavior in Azara's owl monkeys (*Aotus azarae azarae*) in Northern Argentina? *International Journal of Primatology* 38:80–99.
- SHANEE, S., ET AL. 2023a. Traffic and trade in owl monkeys. Pp. 673–692, in Owl Monkeys: Biology, Adaptive Radiation, and Behavioral Ecology of the Only Nocturnal Primate in the Americas (Fernandez-Duque, E., ed.). Springer International Publishing, New York, U.S.A.
- SHANEE, S., ET AL. 2023b. Geographic distribution of Owl Monkeys. Pp. 25–62, in Owl Monkeys: Biology, Adaptive Radiation, and Behavioral Ecology of the Only Nocturnal Primate in the Americas (Fernandez-Duque, E., ed.). Springer International Publishing, New York, U.S.A.
- SLADE, A. 2016. Survivorship, demographics and seasonal trends among electrocuted primate species in Diani, Kenya. Doctoral Thesis. University of Bristol, Bristol, U.K.
- SOTO-CALDERÓN, I. D., ET AL. 2016. Physiological and parasitological implications of living in a city: the case of the white-footed tamarin (*Saguinus leucopus*). *American Journal of Primatology* 78:1272–1281.

- UMAÑA, J. A., ET AL. 1984. Establishment of a colony of nonhuman primates (*Aotus lemurinus griseimembra*) in Colombia. PAHO 18:221–229.
- WEAR, D. N. 2013. Forecasts of land uses. Pp. 45–72, in The Southern Forest Futures Project: Technical Report (Wear, D. N., and J. G. Greis, eds.). Southern Research Station, Asheville, U.S.A.
- WEIBULL, A. C., ÖSTMAN, Ö., AND Å. GRANQVIST. 2003. Species richness in agroecosystems: the effect of landscape, habitat and farm management. *Biodiversity and Conservation* 12:1335–1355.
- WOLOVICH, C. K., ET AL. 2023. A call-to-action to assist in efforts to protect owl monkeys (*Aotus* spp.). *American Journal of Primatology* 86:e23501.

Associated editor: Sergio Solari

Submitted: September 9, 2024; Reviewed: October 23, 2024

Accepted: November 5, 2024; Published on line: December 6, 2024