

Mammals of the Natural National Park Selva de Florencia, Caldas, Colombia

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The Department of Caldas, Central Andes of Colombia, has two National Natural Parks protecting strategic Andean ecosystems. However, the available information on mammals in these protected areas has not been compiled or updated recently. Here, we present an updated inventory of the mammals present in the Selva de Florencia National Natural Park. To construct the inventory, we used historical (museum vouchers) and recent records obtained during field activities over the last 20 years. We used several trapping methods including Sherman and Tomahawk traps, mist nets, and camera traps. We documented 81 mammal species belonging to nine orders, 25 families and 59 genera. Bats (Chiroptera: 30 spp.), rodents (Rodentia: 17 spp.), and carnivores (Carnivora: 13 spp.) were the most diverse groups, representing 73.2 % of recorded species. We also recorded orders such as Didelphimorphia (8 species), Primates (5), Pilosa (3), Artiodactyla (2), Cingulata (2), and Eulipotyphla (1). Also, we recorded two endemic species (*Marmosops chucha* and *Cryptotis colombianus*) and two new species for the Department of Caldas (*Bassaricyon neblina* and *Heteromys* aff. *anomalus*). These species constitute elements of the Andean region and the Nor-Andean and Chocó-Magdalena biogeographic provinces. We highlight the presence of four endangered primates (*Aotus lemurinus*, *Ateles hybridus*, *Cebus versicolor*, and *Saguinus leucopus*), two of which are endemic to Colombia: *S. leucopus* and *C. versicolor*. This work is the baseline to update the management plan of the protected area, from the review of its conservation targets, the definition of the specific management goals, to its effective monitoring.

El departamento de Caldas, Andes Centrales de Colombia, posee dos Parques Nacionales Naturales, que protegen ecosistemas estratégicos de la zona andina. Sin embargo, la información disponible sobre los mamíferos de estas áreas protegidas no ha sido compilada ni actualizada recientemente. Aquí presentamos un inventario actualizado de los mamíferos presentes en el Parque Nacional Natural Selva de Florencia. Para construir el inventario empleamos registros históricos (especímenes en museos) y registros recientes obtenidos en campo en los últimos 20 años. Empleamos varios métodos de trapeos que incluyen trampas Sherman y Tomahawk, redes de niebla, y trampas cámara. Registramos 81 especies de mamíferos pertenecientes a nueve órdenes, 25 familias y 59 géneros. Los murciélagos (Chiroptera: 30 spp.), roedores (Rodentia: 17 spp.) y carnívoros (Carnivora: 13 spp.) representan el 73.2 % de las especies registradas. Otros órdenes registrados son Didelphimorphia (8 especies), Primates (5), Pilosa (3), Cingulata (2), Artiodactyla (2) y Eulipotyphla (1). Además, registramos dos especies endémicas (*Marmosops chucha* y *Cryptotis colombianus*) y dos nuevas especies para el departamento de Caldas (*Bassaricyon neblina* y *Heteromys* aff. *anomalus*). Las especies registradas constituyen elementos de la región andina y de las provincias biogeográficas Norandina y Chocó-Magdalena. Destacamos la presencia de cuatro especies de primates amenazadas (*Aotus lemurinus*, *Ateles hybridus*, *Cebus versicolor* y *Saguinus leucopus*), de las cuales dos son endémicas de Colombia: *S. leucopus* y *C. versicolor*. Este trabajo es la base para la actualización del plan de manejo del área protegida desde la revisión de sus valores objeto de conservación, la definición de objetivos específicos de manejo hasta su monitoreo efectivo.

Keywords: Mist nets; monitoring; photo-trapping; Sherman and Tomahawk traps.

Introduction

The research efforts on mammals of Colombia have increased in recent years, and currently the country ranks sixth in number of species on a global scale (Ramírez-Chaves *et al.* 2016; 2018). In the last 20 years, almost 100 mammal species have been added to the checklist of mammals of the country (see Alberico *et al.* 2000; Ramírez-Chaves *et al.* 2020a). This trend has been driven in part by the increase of taxonomic reviews and updates on South American mammals (Gardner 2008; Patton *et al.* 2015), by the participation of public and private institutions of Colombia, and by the exploration of previously inaccessible areas (Solari *et al.* 2013). Despite the significant advances made on various research topics, there are still knowledge gaps related to the taxonomy and systematics of several groups, and the ecology and conservation of endemic and endangered species for some regions across the country (see Solari *et al.* 2013; Noguera-Urbano *et al.* 2019).

The information gaps are particularly accentuated in protected areas of the country, as most of them lack complete faunal inventories despite mammals being key elements for research and conservation (Roncancio-Duque and Vélez-Vanegas 2019). Mammal's inventories in protected areas have increased in the last decade, especially in large areas such as National Natural Parks (e. g., Mantilla-Meluk *et al.* 2018). In general, there is available information for Natural Parks located in the Amazon region (e. g., Polanco-Ochoa *et al.* 2000; Mantilla-Meluk *et al.* 2018), and specific works on charismatic large mammals such as the cougar (*Puma concolor*) and the Andean bear (*Tremarctos ornatus*) in the Andean region of Colombia (e. g., Hernández-Guzmán *et al.* 2011; Cáceres-Martínez *et al.* 2020).

At the regional level, the Department of Caldas, located in the Andean region of the country (eastern slope of the Western Cordillera and both slopes of the Central Cordillera), 167 mammal species have been registered (Castaño Salazar 2012; Ramírez-Chaves *et al.* 2020b). This number includes limited information on records in protected areas like the National Natural Park (NNP) Selva de Florencia, and NNP Los Nevados (Castaño *et al.* 2003). For example, in the NNP Selva de Florencia, which protects Andean and sub-Andean ecosystems, around 40 species of mammals have been recorded (Castaño *et al.* 2003; Roncancio Duque 2012; Acosta Castañeda *et al.* 2014). This number is likely underestimated, and updated evaluations plus field validations are needed to contribute to the protection of these species and the ecosystems where they are found.

Here, we present the available information on the mammals that inhabit the NNP Selva de Florencia, Central Andes of Colombia. We aim to provide a taxonomic list of mammal species found in the study area and notes on natural history, the methods employed to register them, the localities, elevations, and number of records. This information will serve as baseline for the future research and monitoring plans, as well as to focus more cost-effectively the con-

servation efforts of the mammals of this protected area and the landscape in which it is immersed.

Materials and methods

Study area. The NNP Selva de Florencia is located on the eastern slope of the Central Cordillera, in the municipalities of Pensilvania and Samaná, east of the Department of Caldas, Colombia. The NNP comprises 10,019 ha with an altitudinal gradient between 850 and 2,400 m, and an average annual rainfall of 6,270 mm. This area includes the last Andean rainforest remnants of the current Colombian Coffee Region (Paiba-Alzate *et al.* 2010), that are part of the Magdalena River Basin (Gómez *et al.* 2020), and the Magdalena-Urabá Moist Forests and the Magdalena Valley Montane Forests ecoregions (Olson *et al.* 2001). We sampled localities near the Hondo and San Antonio river basins, and the sectors of the Las Mercedes, Chupaderos I and La Selva microbasins (Figure 1, Table 1).

Data collection. To assess the diversity of mammals in the study area, we conducted sampling efforts in four periods across 2000 and 2018 years: A) October and November 2000. B) April 2001. C) October 2017, and D) February and April 2018. In addition, we implemented 26 sampling points where 30 camera traps (sampling effort: 9,540 camera-days) were randomly located between March 2017 and August 2018. To have a broad taxonomic coverage,

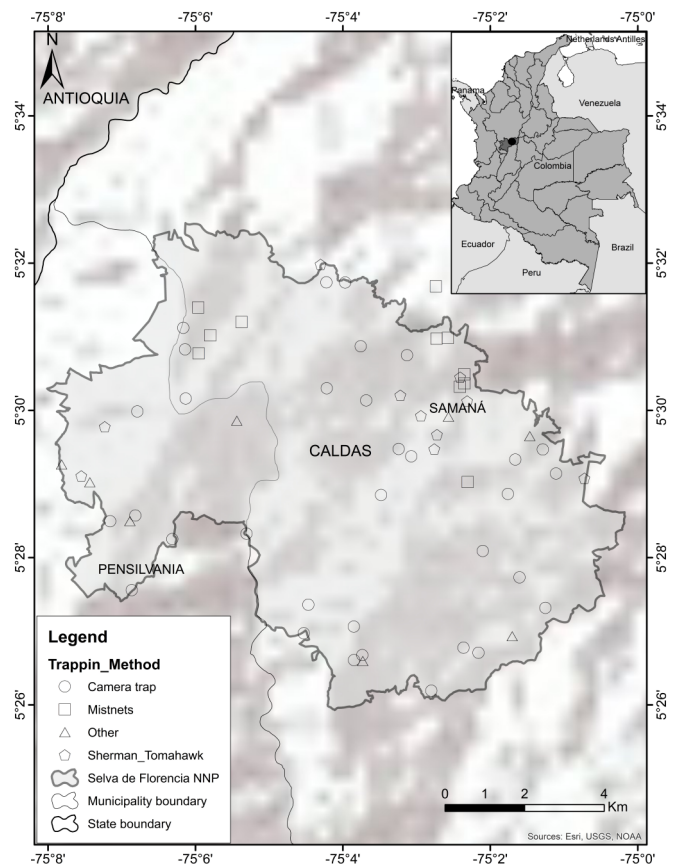


Figure 1. Study area at the Selva de Florencia National Natural Park, Central Andes of the Department of Caldas, Colombia.

we implemented several trapping methods, including Sherman and Tomahawk[®] traps for small non-flying mammals, and mist nets for bats, for 64 effective days. The traps installed were baited with roasted and ground peanuts with bacon and salt, in addition to banana or with canned sardines, chicken bones and a mixture of rolled oats, bananas, banana or vanilla essences, and peanut butter (e. g., [Voss and Emmons 1996](#)). For capturing bats, five mist nets (12m long x 6m wide) were installed in four sampling points, between 18:00 and 23:00 hours. To complement the information, we included incidental captures, observations in the field, search for tracks and occasional interviews with park rangers and inhabitants near the NNP Selva de Florencia. In addition, we reviewed vouchers from the NNP Selva de Florencia or its surroundings deposited at the mammal collection of the Natural History Museum of the University of Caldas (MHN-UCa), Manizales, the Instituto Alexander von Humboldt (IAvH), Villa de Leyva, Colombia, and the Field Museum of Natural History (FMNH), Chicago, USA.

We collected vouchers for taxonomic determination in the laboratory, and prepared them as skin and skull, or in fluid (alcohol) with tissues preserved at 96 % ethanol. All the collected specimens were deposited at the MHN-UCa mammal collection (see [Ramírez-Chaves et al. 2020b](#)). We took cranial and external measurements following to [Simmons and Voss \(1998\)](#) and [Voss et al. \(2001\)](#). Measurements included for selected specimens (Appendix 1): length of head-and-body (HBL); length of tail (LT); length of hindfoot (HF); length of ear (LE); weight (Wt) in grams (g); greatest length of skull (GLS); condylobasal length (CBL); braincase breadth (BB); maxillary toothrow (MTR); molar length (LM); palatal breadth (PB); palatal length (PL); nasal breadth (NB); Least interorbital breadth (LIB); least postorbital breadth (LPB); zygomatic breadth (ZB); breadth of the zygomatic plate (BZP); rostral breadth (BR); length of diastema (LD); breadth of the first maxillary molar (BM1); length of one incisive foramen (LIF); breadth across both incisive foramina (BIF); interparietal breadth (IPB). For bats we also took the forearm length (FL); condylocanine length (CCL); condyloincisive length (CIL); lacrimal breadth (LB); mastoid breadth (MB); breadth across canines (BC-C), and width across upper molars (BM-M). Taxonomic identification was done using specialized literature and taxonomic keys mainly for marsupials ([Gardner 2008](#); [Voss et al. 2018, 2020](#); [Giarla and Voss 2020](#)), bats ([Gardner 2008](#); [Díaz et al. 2016](#)), rodents ([Patton et al. 2015](#)), and carnivores ([Suárez-Castro and Ramírez-Chaves 2015](#)). For marsupials, we include one species as *Marmosa* sp. which is morphologically similar to *M. meridae* but a molecular confirmation is needed.

As additional support for taxonomic identification of some rodents collected between 2017 and 2018, we implemented a *Cytb*-based (Cytochrome B) molecular approach. This marker has been traditionally used for studying mammalian alpha-taxonomy because of its strength to detect cryptic diversity, especially in widely distributed and morphologically homogeneous taxa. Thus, species selected

for *Cytb* characterization have broad geographic ranges or have been pointed out as including undocumented taxonomic variation ([Patton et al. 2015](#)): *Coendou quichua*, *Neacomys tenuipes*, *Heteromys* aff. *anomalus*, and *Sigmodontomys alfari*. DNA was extracted from fresh tissues of these species with a GeneJet Genomic DNA Purification Kit (Thermo Fisher Scientific), following the manufacturer's instructions. Resulting sequences were verified to represent endogenous DNA of *Coendou*, *Neacomys*, *Heteromys*, and *Sigmodontomys* by performing independent searches with the Basic Alignment Search Tool (BLAST; [Altschul et al. 1990](#)). Matches with identities above 95 % were considered as good candidate species to our samples, according to the genetic species concept ([Bradley and Baker 2001](#)). We generated a total of six *Cytb* sequences: a) One 1,140 base pairs sequence from *Coendou quichua* (MT822488). b) Two sequences of 688 bp and 703 bp of *Heteromys* aff. *anomalus* (Acr1 and Acr2, respectively). c) Three sequences of 872-775 bp sequence from the specimens of *Neacomys tenuipes* (MT536169-MT536171). d) One 866 bp sequence from *Sigmodontomys alfari*. We assessed potential cryptic diversity with a close comparison of our sequences with all the sequences of *N. tenuipes*, *H. anomalus*, *H. australis*, and *S. alfari*, available in GenBank. Finally, the conservation status of the species, especially endemic and threatened, was evaluated with the context of current legislation ([MADS 2017](#)), and the International Union for the Conservation of Nature (IUCN 2019). For the endemic species, we include the ecoregions where they inhabit (sensu [Olson et al. 2001](#)).

Results

We recorded a total of 81 mammal species at the NNP Selva de Florencia. The mammals registered belong to 9 orders, 25 families and 59 genera (Table 1). Bats (Chiroptera: 30 spp.), rodents (Rodentia: 17 spp.), and carnivores (Carnivora: 13 spp.) represent 71.4 % of the recorded species. Other orders registered are Didelphimorphia (8 spp.), Primates (5 spp.), Pilosa (3 spp.), Artiodactyla (2 spp.), Cingulata (2 spp.), and Eulipotyphla (1 spp.). We recorded 43 species during 2000 and 2001, and 34 during 2017 and 2018 (Figure 1). Using trapping methods, we captured 330 specimens of bats (mist nets), 24 rodents (Sherman), and 4 marsupials (Tomahawk; Figure 2). The taxa recorded by camera traps include six orders (Didelphimorphia, Cingulata, Pilosa, Carnivora, Artiodactyla and Rodentia) and 16 species (Figure 3). In addition, we recorded 28 species through manual captures, observations, and other indirect records.

Didelphimorphia. We recorded a total of eight species of seven genera in the study area (Table 2), using Tomahawk traps (four species) and direct observations (one species). The review of collections contributed with three additional species (Table 2). In camera traps, only four records of *Didelphis marsupialis* were obtained in August and December 2017, in two localities at elevations of 1,078 and 1,571 m, respectively. We highlight the presence two species of the genus *Marmosa* (*Marmosa* sp., and the short-furred woolly

Table 1. Sampled localities and dates (day, month, year) at the Selva de Florencia National Natural Park, Department of Caldas, Central Andes of Colombia

| | Code / Locality | Latitude | Longitude | Elevation (masl) | Date |
|---|--|----------------|------------------|------------------|--------------------------|
| Municipality of Pensilvania, "Corregimiento" Pueblo Nuevo | | | | | |
| 1 | Vereda El Paraíso | 5° 29' 51.7" N | -75° 05' 26.3" W | 2,224 | 19.03.2019 |
| 2 | Vereda Las Colonias | 5° 29' 06.6" N | -75° 07' 32.9" W | 1,733 | 26.10.2015 |
| | Vereda Las Colonias | 5° 29' 16.0" N | -75° 07' 48.9" W | 1,530 | 26.10.2015 |
| | Vereda Las Colonias | 5° 29' 01.5" N | -75° 07' 25.9" W | 1,752 | 26.10.2015 |
| 3 | Vereda Buenos Aires, sector Montebello, predio Segundo Zuluaga | 5° 28' 29.9" N | -75° 06' 53.3" W | 2,088 | March-July 2016 |
| | Buenos Aires, sector Montebello | 5° 28' 34.4" N | -75° 06' 48.9" W | 2,082 | 26.10.2016 - 05.12.2016 |
| | Buenos Aires, sector Montebello | 5° 28' 29.7" N | -75° 07' 09.4" W | 2,167 | 26.10.2016 - 05.12.2016 |
| 4 | Vereda El Silencio | 5° 29' 46.7" N | -75° 07' 13.8" W | 1,620 | Feb.-May 2014 |
| 5 | Vereda Miraflores, sector Cuchilla de Miraflores | 5° 30' 09.7" N | -75° 06' 07.9" W | 1,980 | 26.07.2016 - 28.09.2016 |
| | Vereda Miraflores, sector Cuchilla de Miraflores | 5° 30' 49.8" N | -75° 06' 08.4" W | 1,986 | 28.10.2016 - 06.12.2016 |
| | Vereda Miraflores, Reserva La Italia | 5° 31' 07.3" N | -75° 06' 09.9" W | 1,951 | 12.07.2018 - 30.08.2018 |
| 6 | Vereda San Francisco, sector Boquerón | 5° 27' 33.6" N | -75° 06' 51.8" W | 1,920 | 08.11.2017 - 11.12.2017 |
| | Vereda San Francisco, sector Boquerón | 5° 28' 15.2" N | -75° 06' 18.8" W | 1,999 | 02.05.2018 - 05.06.2018 |
| 7 | Vereda Las Mercedes | 5° 29' 59.2" N | -75° 06' 47.3" W | 1,818 | 11.04.2018 - 15.05.2018 |
| Municipality of Samaná, "Corregimiento" de Florencia | | | | | |
| 8 | Vereda San Antonio | 5° 30' 22" N | -75° 02' 21.0" W | 1,300 | 07.10.2017 |
| | Vereda San Antonio, Microcuenca Las Mercedes | 5° 30' 27.1" N | -75° 02' 24.5" W | 1,227 | |
| | Microcuenca Las Mercedes | 5° 30' 07.7" N | -75° 02' 18.8" W | 1,066 | |
| | Microcuenca Las Mercedes | 5° 30' 29.5" N | -75° 02' 21.2" W | 1,275 | |
| | Microcuenca Las Mercedes | 5° 30' 19.3" N | -75° 02' 24.7" W | 1,259 | 20.02.2018-24.02.2018 |
| | Sector El Hoyo, cráter volcán El Escondido | 5° 30' 58.5" N | -75° 02' 43.7" W | 2,224 | 27.08.2018 |
| 9 | Vereda La Cabaña | 5° 31' 41.4" N | -75° 02' 44.3" W | 1,200 | 05.01.2001 |
| | Vereda La Cabaña | 5° 29' 28.2" N | -75° 01' 17.3" W | 1,382 | 29.01.2018 - 08.03.2018 |
| | Sector La Vega | 5° 29' 01.7" N | -75° 02' 18.4" W | 1,450 | March-June 2014 |
| | Sector La Vega | 5° 28' 52.0" N | -75° 01' 45.7" W | 1,375 | 16.08.2017 - 16.09.2017 |
| | Sector La Vega | 5° 29' 20.0" N | -75° 01' 39.7" W | 1,078 | 27.11.2017 - 17.01.2018 |
| | Predio San Antonio | 5° 29' 39.1" N | -75° 01' 27.9" W | 1,458 | 06.04.2016 - 05.05.2016 |
| 10 | Vereda San Vicente, Finca Jose Luis Orozco | 5° 31' 59.0" N | -75° 04' 18.1" W | 1,700 | 12.12.2001 |
| 11 | Vereda San Lucas, cinco minutos abajo casa Miguel Molano, quebrada San Lucas | 5° 30' 12.4" N | -75° 03' 13.2" W | 1,285 | 10.07.2001 |
| | Microcuenca La Selva, cráter volcán El Escondido, sector Coliadero | 5° 30' 59.1" N | -75° 02' 34.5" W | 1,478 | 18.10.2017-20.10.2017 |
| | Transecto altitudinal en el sector Coliadero | 5° 30' 00.0" N | -75° 03' 00.0" W | 1,536-1,809 | 18.10.2017-20.10.2017 |
| | Microcuenca Chupaderos 1 | 5° 29' 55.7" N | -75° 02' 56.5" W | 1,309 | 21.04.2018-23.04.2018 |
| | Microcuenca Chupaderos 1 | 5° 29' 28.6" N | -75° 02' 45.6" W | 1,423 | |
| | Microcuenca Chupaderos 1 | 5° 29' 40.3" N | -75° 02' 43.4" W | 1,438 | 21.04.2018-23.04.2018 |
| | Río San Antonio | 5° 29' 54.9" N | -75° 02' 34.0" W | 1,330 | 04.2018 |
| | San Lucas | 5° 30' 45.0" N | -75° 03' 07.8" W | 1,636 | 21.03.2017 - 14.04.2017; |
| | San Lucas | 5° 30' 08.2" N | -75° 03' 41.0" W | 1,482 | 28.06.2017 - 30.07.2017 |
| | San Lucas | 5° 29' 28.6" N | -75° 03' 14.6" W | 1,290 | 29.06.2017 - 30.07.2017 |
| | San Lucas | 5° 29' 22.6" N | -75° 03' 04.3" W | 1,463 | 29.06.2017 - 30.07.2017 |
| | San Lucas | 5° 28' 51.1" N | -75° 03' 28.9" W | 1,581 | 29.08.2017 - 13.10.2017 |
| | San Lucas | 5° 30' 18.1" N | -75° 04' 13.1" W | 1,719 | 30.08.2017 - 14.10.2017 |
| | Sector Sierra Morena | 5° 30' 52.3" N | -75° 03' 45.5" W | 2,034 | 26.04.2017 - 15.06.2017 |
| 12 | Vereda La Abundancia, cuenca del Río Hondo | 5° 31' 01.2" N | -75° 05' 47.9" W | 1,538 | 23.08.2017 - 03.10.2017 |
| | Cuchilla del Dulce | 5° 31' 1.34" N | -75° 04' 53.0" W | 1,470-1,800 | 19.11.2000 - 21.11.2000 |
| | Mina La Concha, cabecera del riachuelo | 5° 30' 46.5" N | -75° 05' 57.4" W | 1,980 | 16.04.2001 |
| | Quebrada Seca, 40 minutos aguas arriba vía Florencia-Pueblo Nuevo | 5° 31' 23.9" N | -75° 05' 57.7" W | 1,800 | 05.07.2001 |
| | Caño Las Agüitas | 5° 31' 12.1" N | -75° 05' 22.4" W | 1,573 | |
| 13 | Vereda Río Claro, sector Bocatomas | 5° 30' 22.0" N | -75° 02' 21" W | 1,300 | 07.10.2017 |
| 14 | Vereda La Bretaña | 5° 31' 44.3" N | -75° 03' 58.1" W | 1,819 | 10.06.2017 - 13.07.2017 |
| | Vereda La Bretaña | 5° 31' 44.4" N | -75° 04' 13.4" W | 1,783 | 17.05.2017 - 21.06.2017 |

Table 1. Continuation...

| | Code / Locality | Latitude | Longitude | Elevation (masl) | Date |
|----|--|----------------|------------------|------------------|-------------------------|
| 15 | Vereda Las Encimadas | 5° 29' 04.7" N | -75° 00' 43.5" W | 1,008 | 05.07.2017 - 09.08.2017 |
| | Vereda Las Encimadas | 5° 29' 08.6" N | -75° 01' 06.5" W | 1,361 | 25.10.2017 - 26.11.2017 |
| | Municipality of Samaná, "Corregimiento" Encimadas, | | | | |
| 16 | Vereda Yarumalito, sector cuchilla El Micay | 5° 26' 35.8" N | -75° 03' 43.8" W | 1,856 | 23.05.2016 - 01.06.2016 |
| | Vereda Yarumalito, sector cuchilla El Micay | 5° 26' 40.6" N | -75° 03' 44.2" W | 1,873 | |
| | Vereda Yarumalito, sector cuchilla El Micay | 5° 26' 36.5" N | -75° 03' 50.9" W | 2,306 | 19.07.2017 - 22.08.2017 |
| 17 | Vereda El Quindío | 5° 26' 42.5" N | -75° 02' 09.6" W | 1,513 | 20.06.2017 - 21.07.2017 |
| | Vereda El Quindío | 5° 26' 11.6" N | -75° 02' 48.0" W | 1,744 | 20.10.2017 - 22.11.2017 |
| | Vereda El Quindío | 5° 26' 46.6" N | -75° 02' 21.8" W | 1,409 | 31.07.2018 - 04.09.2018 |
| | Sector Los Planes | 5° 26' 56.0" N | -75° 01' 42.2" W | 1,471 | 21.06.2016 - 21.07.2016 |
| 18 | Vereda El Diamante | 5° 28' 05.5" N | -75° 02' 06.1" W | 1,552 | 22.06.2017 - 25.07.2017 |
| | Vereda El Diamante | 5° 27' 19.1" N | -75° 01' 15.2" W | 1,374 | 21.06.2017 - 26.07.2017 |
| | Predio El Retiro | 5° 27' 44.0" N | -75° 01' 36.3" W | 1,384 | 23.06.2017 - 25.07.2017 |
| 19 | Vereda Santa Isabel | 5° 27' 21.7" N | -75° 04' 28.1" W | 1,917 | 04.07.2017 - 09.08.2017 |
| | Vereda Santa Isabel | 5° 26' 58.4" N | -75° 04' 31.8" W | 1,861 | 03.07.2017 - 07.08.2017 |
| | Río Tenerife | 5° 28' 19.6" N | -75° 05' 18.4" W | 1,559 | 25.09.2017 - 26.10.2017 |
| | Sector La Gruta | 5° 27' 03.8" N | -75° 03' 51.1" W | 1,870 | 19.06.2018 - 24.07.2018 |

mouse opossum, *Marmosa regina*, the latter considered a senior synonym of *M. isthmica* by [Giarla and Voss 2020](#) which are differentiated based on size (Appendix 1), tail and coat coloration, and skull morphology.

Eulipotyphla. We recorded only one species (*Cryptotis colombianus*), based on a male specimen (MHN-UCa 193: skin and skull) collected in the San Vicente village, 1,700 m (28 December 2001). External measurements are: TL: 96, HB: 69, Tail: 27, feet: 12, W: 7 g. LT/HB: 39.13 %. Cranio-dental skull measurements are: condylobasal length: 19.68, cranial amplitude: 9.53, zygomatic plate width: 3.91, interorbital width: 40.8, length of unicuspid teeth row: 3.78, mandibular length: 7.50, mandibular tooth row length: 5.38, width between upper second molars: 6.00 mm. One additional specimen of *Cryptotis* was captured but not collected in 2014 and the specific identity is uncertain.

Cingulata and Pilosa. We registered five species in the study area. One species of Cingulata (*Dasyus novemcinctus*) and two of Pilosa (*Choloepus hoffmanni* and *Tamandua mexicana*) were documented using direct observations and indirect records (bones). *Cyclopes dorsalis* was photographed in 2012 near to a farm in the study area. Based on camera traps, we obtained seven records of *Cabassous centralis* in June, October, and November 2017, in three locations at of 1,361, 1,744 and 1,783 masl. Similarly, we obtained a total of 17 records for *D. novemcinctus* during June to September and December 2017 and in February and May 2018, in 11 locations located at elevations between 1,078 and 1,999 m. For Pilosa, we obtained eight records of *T. mexicana* between July and October 2017 in six locations with elevations between 1,008 and 1,719 m.

Chiroptera. We registered a total of 30 species of two families (Phyllostomidae and Vespertilionidae; Table 2). Bats were the best represented group in terms of richness

with 12 (152 captured individuals) and 16 species (179 individuals captured), during 2000 to 2001 and 2017 to 2018, respectively. The most abundant species was *Carollia brevicauda* with 17 (2000 to 2001) and 100 (2017 to 2018) captured individuals. We highlight the presence of three species of small *Artibeus* (*anderseni*, *bogotensis*, and *glauca*) (Appendix 1), which are differentiated based on the number of lower molars (two or three), and skull morphology.

Carnivora. We registered a total of 13 species of Canidae, Felidae, Mustelidae, and Procyonidae (Table 1). During 2000 and 2001, we recorded nine species based on indirect records. During 2017 to 2018 we registered four species based on indirect records and observations, one of them (*Bassaricyon neblina*) had no previous records at the NNP or for the Department of Caldas. The specimen was identified as *N. neblina* based on the long dorsal hair coat, dense and of rufous coloration with black tips, the fur of the belly pale yellowish; the face has a medium and pointed muzzle of dark-gray coloration, eyes are big and brown, ears are rounded with hairs, and the tail is proportionately short (412 mm), bushier and straight becoming darker at the tip. In camera traps, we obtained total of 19 records of individuals of the four families. Among these, four records of *Eira barbara* (Mustelidae) in July, October, and December 2017 and May 2018, in four locations located at elevations between 1,692 and 1,599 m. For Procyonidae, we obtained five records of *Nasua nasua* between June and September 2017, and May 2018 in five localities between 1,463 and 1,999 m. In addition, a record of *Procyon cancrivorus* in July 2017 at 1,917 m elevation. For Felidae, we recorded *Herpailurus yagouaroundi* in September 2017 in a locality at 1,375 m; six records of *Leopardus pardalis* between June and September 2017, and February 2018, in five localities at elevations between 1,382 and 2,306 m. In addition, four

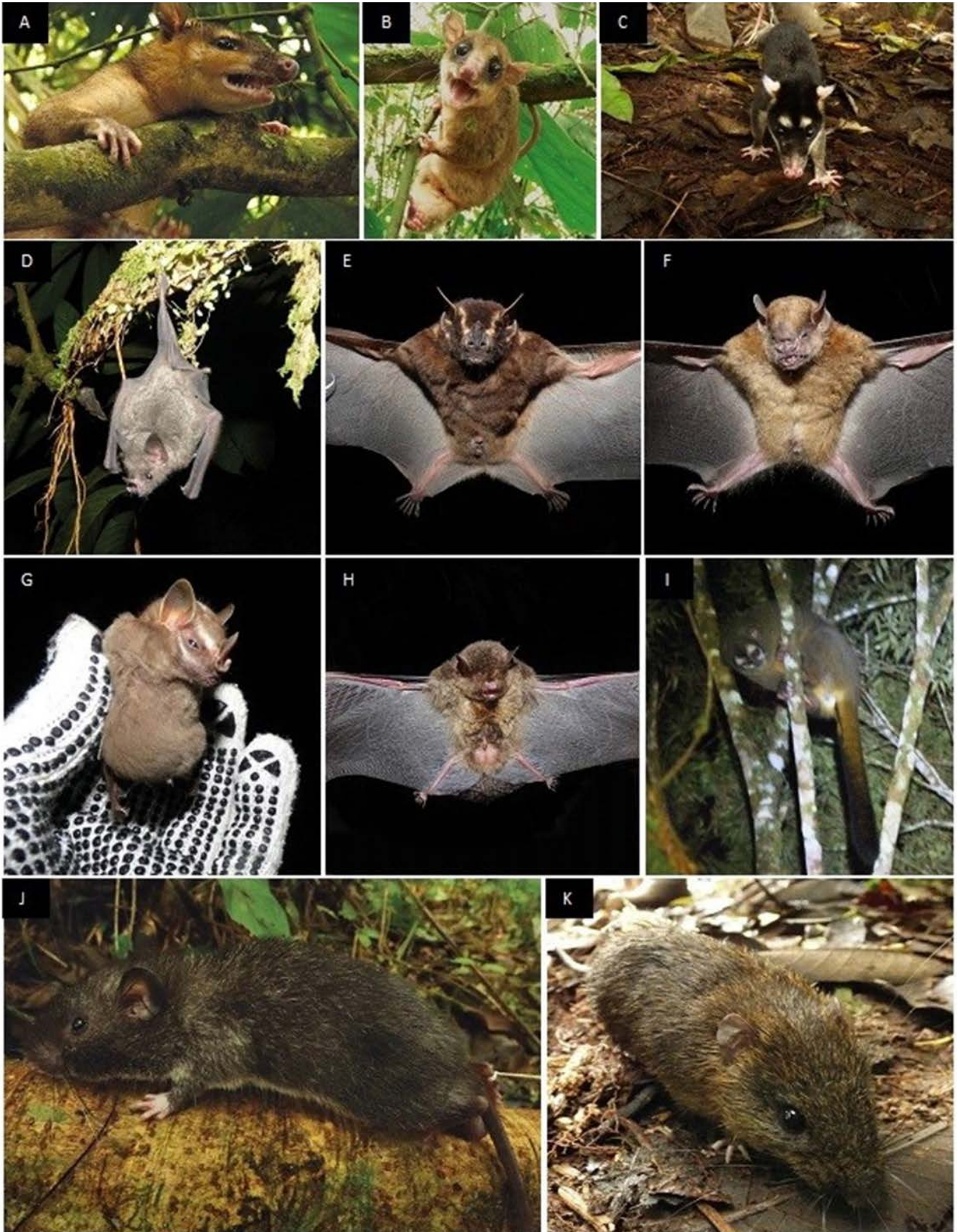


Figure 2. Small mammal species captured and observed in 2017 and 2018: Didelphimorphia: A) *Metachirus myosuros*. B) *Marmosa regina/isthmica*. C) *Philander melanurus*. Chiroptera: D) *Carollia brevicauda*. E) *Enchisthenes hartii*. F) *Sturnira parvidens*. G) *Vampyressa thyone*. H) *Myotis keaysi*. Primates: I) *Aotus lemurinus*. Rodentia: J) *Heteromys aff. anomalus*. K) *Neacomys tenuipes*.

records of *L. wiedii* in August and September 2017, and April 2018, in three localities with elevations between 1,719 and 2,306 m. Finally, in May and June 2017, we reported *L. tigrinus* twice in different locations at 1,374 and 1,738 m elevation. Cranial measurements of three specimens from the study area are shown in Appendix 1.

Artiodactyla. We confirmed the presence of two families (Cervidae and Tayassuidae) and two species. *Dicotyles tajacu* (Tayassuidae) was registered based on indirect records and by camera traps (16 events) in July, September, October, and November 2017, and in February, March, and May 2018 at elevations between 1,382 and 1,999 m. The dwarf brocket deer, *Mazama rufina* (Cervidae) was recorded based on incidental records and observations.

Primates. We reported five species (*Aotus lemurinus*, *Alouatta seniculus*, *Ateles hybridus*, *Cebus versicolor* and *Saguinus leucopus*) of three families (Atelidae, Cebidae, and Callitrichidae) by direct observation. A predation event by an unidentified eagle on an individual of *Aotus lemurinus* was registered by the local community in March 2020.

Rodentia. We registered 16 species from seven families at the NNP Selva de Florencia (Table 1; Appendix 1). During 2000 and 2001, we reported seven species, five captured individuals and three species, based on dead specimens or bone fragments. During 2017 to 2018, rodents contributed with five species (19 captured individuals and two species recorded by dead specimens or bone fragments), with *Heteromys* aff. *anomalus* as the most abundant with 13 captures. We reported two species of *Nephelomys* which are differentiated based on the frequency of ventral white patches, the size of the posterolateral palatal pits and the shape of the palatal fossae. Using camera traps, we found that *Dasyprocta punctata* and *Cuniculus paca* were the species with the highest number of records (125 and 56, respectively). In addition, we obtained 14 records of *Syntheosciurus granatensis* plus 133 of unidentified rodents.

The BLAST query with our sequence of *Coendou quichua* recovered two sequences from GenBank (accessions and KC863881) with percentages of identity of 98.86 % and 95.87 %. The first (KC463882) was obtained from another Colombian specimen (Department of Cesar), whereas the second corresponds to an Ecuadorian specimen. This result unequivocally supports that the specimen we collected in the NNP Selva de Florencia belongs to this species.

Our sequences of *H. aff. anomalus* obtained identity values of 90.18 % and 90.04 % with sequences of *H. australis* (GU646927 and GU646928) from Panama, and 90.18 % with sequences of *H. anomalus* from Venezuela (DQ168468). This result suggests that specimens from the Selva de Florencia Natural Park identified morphologically as *H. aff. anomalus*, cannot be assigned to this species on basis on molecular data. The percentages of identity below 95 % with respect to all *Cytb* sequences of the genus even indicate they are not assignable to any of the known species

(at least those genetically characterized for this marker). The name *Heteromys (Heteromys) anomalus hershkovitzi* Hernández-Camacho, 1956 was suggested for populations of this genus from the Magdalena River basin in Colombia, and it is an available name for this taxon. The assignation and revalidation of this name to the populations of Selva de Florencia identified as *H. aff. anomalus* is needed.

For *Neacomys tenuipes*, our two sequences are 100 % identical. The highest genetic score (93.02 %) was obtained with a sequence of *N. rosalingae* (KY859763) from Peru. The only sequence of *N. tenuipes* available in GenBank (also from Colombia) was not recovered in the queries, probably due to its short length (only 177 bp). Thus, with identities below 95 % with respect to other *Neacomys Cytb* sequences in Genbank, and without larger sequences of *N. tenuipes* available to compare, specimens of the NNP Selva de Florencia cannot be molecularly assigned to any species in the genus. However, considering these specimens present all the morphological diagnostic character for *N. tenuipes*, sequences generated here can be considered the most complete publicly available. Finally, for our sequence of *S. alfari*, four matches with highest percentages of identity were of the same species: 96.88 % compared to an Ecuadorian specimen (EU340016), and three with the same value of 95.61 % from specimens collected in Panama (KY754155, GU126548, EU074635).

Threatened categories and endemic species. We identified eight species listed in threatened categories according to the national legislation (MADS 2017), and in the Red List of the International Union for the Conservation of Nature and Natural Resources (IUCN 2019). The most threatened species include the primates *Ateles hybridus* (Critically Endangered - CR), *Aotus lemurinus* (Vulnerable - VU), *Cebus versicolor* and *Saguinus leucopus* (Endangered - EN), the latter is considered Vulnerable according to Colombian legislation (MADS 2017). Other species in a threaten category include the carnivores *Leopardus tigrinus* and *Lontra longicaudis*, the dwarf brocket deer *Mazama rufina* (all listed globally as VU), and the pacarana *Dinomys branickii* listed as VU in Colombia (MADS 2017). The endemic species registered are: *Cryptotis colombianus* distributed in one ecoregion (the Magdalena Valley Montane Forest), *Saguinus leucopus* distributed in two ecoregions (Magdalena-Urabá Moist Forests, and *Nephelomys pectoralis* in two (Cauca Valley Montane Forests, and Northwest Andean Montane Forests), *Nephelomys childi* in three (Cauca Valley Montane Forests, Cordillera Oriental Montane Forests, and Northwest Andean Montane Forests), *Marmosops chucha*, distributed in four ecoregions (Cauca Valley Dry Forests, Magdalena-Urabá Moist Forests, Northwest Andean Montane Forests, and Magdalena Valley Montane Forests), and *Cebus versicolor* in five ecoregions (Guajira-Barranquilla Xeric Scrub, Magdalena-Urabá Moist Forests, Magdalena Valley Dry Forests, Magdalena Valley Montane Forests, and Sinú Valley dry Forests).

Table 2. List of mammals reported at the Parque Nacional Natural, Selva de Florencia. For bats, the number of captured individuals is included. Abbreviations are, CT: Camera trap records, Ob: Observation, To: Tomahawk, Sh: Sherman, Ind: indirect record (bones or tracks). For Carnivora, A: 2012. Obs. NNP Rangers (Weimar Hincapie – Uriel Quiceno): sector La Vega. B: Obs. 2013 (Weimar Hincapie) at quebrada Las Mercedes, Near río San Antonio, Vereda San Lucas, Florencia. C: 2019. Obs. (Hugo Ballesteros and Rigoberto Lancheros), two individuals at vereda La Abundancia. NPL: the locality is Río Hondo (a river inside the Park), but not precise locality is available. *Endemic species. Localities are explained in Table 1. Voucher specimens are housed at the MNH-UCa unless otherwise specified.

| Taxon | Year | | Vouchers or type of record | Localities |
|--------------------------------|------------|-----------|--|-----------------------------|
| | 2000-2001 | 2017-2018 | | |
| DIDELPHIMORPHIA | | | | |
| <i>Chironectes minimus</i> | 1 Ob | | 218 | 12 |
| <i>Didelphis marsupialis</i> | 1 To, 2 Ob | | 208, 2427-2428 | 11 |
| <i>Marmosa regina/isthmica</i> | | 1 Sh | 1612, FMNH 70978 | 8, NPL |
| <i>Marmosa</i> sp. | | | 876 | 2 |
| <i>Marmosops chucha</i> * | | | FMNH 70925 | NPL |
| <i>Metachirus myosuroides</i> | | 1 Sh | 1613, 3165 | 8 |
| <i>Monodelphis adusta</i> | | | 227 (lost); 263 | NPL |
| <i>Philander melanurus</i> | | 1 Sh | 1614 | 8 |
| EULIPOTYPHLA | | | | |
| <i>Cryptotis colombianus</i> | 1 | | 193 | 10 |
| CINGULATA | | | | |
| <i>Cabassous centralis</i> | | | 4 CT | 14, 15, 17 |
| <i>Dasypus novemcinctus</i> | | | 201, 1800, 2430, (18 CT) | 6, 8, 9, 11, 14, 17, 18, 19 |
| PILOSA | | | | |
| <i>Cyclopes dorsalis</i> | | | Photographs | NPL |
| <i>Choloepus hoffmanni</i> | | 1 obs | 197, 1615, 2424-2425, 3160-3163 | 11, 13 |
| <i>Tamandua mexicana</i> | | | 2426, (8 CT) | 1, 9, 11, 14, 15, 18 |
| CHIROPTERA | | | | |
| Phyllostomidae | | | | |
| <i>Carollia brevicauda</i> | 1 | 100 | 019-032, 035, 037, 043, 048, 055, 062, 065, 069-074, 076, 083, 088, 095, 097, 099-100, 166-168, 175, 236, 239, 243, 1603, 1634, 1635, 1638 | 3, 8, 11, 12 |
| <i>Carollia castanea</i> | | 18 | 1636; 1637; 1673 | 3, NPL |
| <i>Carollia perspicillata</i> | | 9 | 22, 91, 1672 | 3, NPL |
| <i>Desmodus rotundus</i> | 1 | | Interviews | |
| <i>Anoura cultrata</i> | 2 | | 94, 171 | 2, 10 |
| <i>Anoura fistulata</i> | 1 | | 44 | 3 |
| <i>Anoura caudifer</i> | 4 | | 58, 59, 60, 78 | 12 |
| <i>Anoura geoffroyi</i> | 1 | | | NPL |
| <i>Micronycteris megalotis</i> | | 1 | 1632 | 8 |
| <i>Artibeus lituratus</i> | | 6 | 1639, 1640, 1678 | 11, NPL |
| <i>Artibeus anderseni</i> | | 5 | 1641 | 11 |
| <i>Artibeus bogotensis</i> | | 3 | 1642 | 11 |
| <i>Artibeus glaucus</i> | 1 | | 0172 | 10 |
| <i>Chiroderma salvini</i> | 2 | | 0067, 0081 | 12 |
| <i>Enchisthenes hartii</i> | 1 | 1 | 66, 77, 237, 240, 259, 1633 | 11, 12 |
| <i>Phyllostomus discolor</i> | 1 | | 0089 | 11 |
| <i>Platyrrhinus albericoi</i> | | 3 | 1644, 1645 | 11 |
| <i>Platyrrhinus dorsalis</i> | 1 | | 0034, 0082, 0087, 0090 | 11, 12 |
| <i>Platyrrhinus helleri</i> | 1 | 7 | 0045, 1643, 1663 | 11 |
| <i>Platyrrhinus ismaeli</i> | 1 | | 0038, 0063, 0085, 0170 | 10, 11, 12 |
| <i>Sturnira bogotensis</i> | | 5 | 0042, 0047, 0084, 0093, 1056, 1652, 1654 | 11, 12, NPL |
| <i>Sturnira erythromos</i> | | | 0080, 0084, 0234 | 12 |
| <i>Sturnira parvidens</i> | 1 | 6 | 24-25, 29, 39-41, 49, 51, 53-54, 64, 68, 1649, 1651, 1678 | 8, 11, 12 |
| <i>Sturnira oporophilum</i> | 1 | 8 | 0061 | 12 |
| <i>Vampyressa thyone</i> | | 5 | 0073, 1646, 1647, 1676 | 8, 11, 12 |

Table 2. Continuation...

| Taxon | Year | | Vouchers or type of record | Localities |
|-----------------------------------|-----------|------------|--|--|
| | 2000-2001 | 2017-2018 | | |
| VESPERTILIONIDAE | | | | |
| <i>Eptesicus chiriquinus</i> | 1 | | 147 | 12 |
| <i>Myotis caucensis</i> | 1 | | 50, 152 | 12 |
| <i>Myotis riparius</i> | | 2 | 1657, 1658 | 11 |
| <i>Myotis keaysi</i> | | 1 | 1659 | 11 |
| CARNIVORA | | | | |
| <i>Leopardus pardalis</i> | | 1 | (8 CT), Ind. | 6, 9, 14, 17, 18 |
| <i>Leopardus tigrinus</i> | | | 205, (2 CT) | 9, 14, 18 |
| <i>Leopardus wiedii</i> | | | 4 CT, photographs | 6, 11, 14 |
| <i>Herpailurus yagouaroundi</i> | | | 1 CT, photographs | 9 |
| <i>Puma concolor</i> | | | Skull, FMNH 70567 | NPL |
| <i>Cerdocyon thous</i> | 1 | | Skull, 0200 | NPL |
| <i>Eira barbara</i> | | | (6 CT) | 5, 6, 7, 14, 18 |
| <i>Bassaricyon neblina</i> | | 1 | 1631 | 13 |
| <i>Nasua nasua</i> | 1994 | 1 | (6 CT), IAvH 7318 | 6, 11, 14, 17, 19, NPL |
| <i>Potos flavus</i> | 1 | 1 | 3164, Obs, video | 10 |
| <i>Procyon cancrivorus</i> | | | (1 CT), photographs | 19 |
| <i>Lontra longicaudis</i> | | | A, B, C. | 12 |
| <i>Mustela frenata</i> | | 1 | Obs. | 2 |
| ARTIODACTYLA | | | | |
| <i>Mazama rufina</i> | | 1 | Obs. | 3 |
| <i>Pecari tajacu</i> | | | 1668, (17 CT) | 5, 6, 7, 9, 11, 14, 18 |
| PRIMATES | | | | |
| <i>Alouatta seniculus</i> | | 1- 9 ind | 3159, Obs. | 4, 6, 7, 8, 9, 11, 12, 15, 17, 18, 19, NPL |
| <i>Ateles hybridus</i> | | 3 ind | Obs. | 4, 9, 16 |
| <i>Aotus lemurinus</i> | | 3 ind | Obs. | 11, 16 |
| <i>Cebus versicolor*</i> | | 1 - 15 ind | Obs. | 6, 11, 12, 17, 18 |
| <i>Saguinus leucopus*</i> | | 1 - 14 ind | Obs. | 2, 8, 9, 15, 16, 17, 19 |
| RODENTIA | | | | |
| <i>Syntheosciurus granatensis</i> | 1 | Obs | 16 CT | 5, 7, 9, 11, 14, 17, 18, 19 |
| <i>Leptosciurus pucheranii</i> | | 1 | Photographs | 1, 2, 5, 16, 18 |
| <i>Heteromys australis</i> | 1 | | FMNH 71185-71190 | NPL |
| <i>Heteromys aff. anomalus</i> | | 13 Sh | 1617, 1618, 1619, 1620 | 11 |
| <i>Handleyomys alfaroi</i> | | | FMNH 72062, 72073-72075, 72077-72080 | NPL |
| <i>Melanomys caliginosus</i> | | | FMNH 71816-71822 | NPL |
| <i>Neacomys tenuipes</i> | | 5 Sh, 1 ma | 1627, 1628, 1692 | 8, NPL |
| <i>Nephelomys childi*</i> | 1 | | 771, 772 | 12 |
| <i>Nephelomys pectoralis*</i> | | | 185, 188, 189, 190 | 12 |
| <i>Sigmodontomys alfari</i> | | 1 Sh | 1630 | 8 |
| <i>Tylomys mirae</i> | | | FMNH 71215 | NPL |
| <i>Transandinomys talamancae</i> | | | FMNH 72063, 72066 | NPL |
| <i>Rhipidomys latimanus</i> | 1 | | 1690-1691 | 7 |
| <i>Coendou quichua</i> | | 2 ind | 1616, 2422-2423, (1 CT) | 11 |
| <i>Cuniculus paca</i> | 1 | | 1811-1812, (58 CT) | 5, 9, 11, 14, 17, 18, 19, NPL |
| <i>Dasyprocta punctata</i> | 1 | 1 ind | 1607, (136 CT) | 7, 9, 11, 14, 15, 17, 18, 19 |
| <i>Dinomys branickii</i> | | | 216-217, 883, (1 CT), 1 Photograph, IAvH 19984 | 10, 17, NPL |

Discussion

To our knowledge, the inventory of mammalian species at the NNP Selva de Florencia is one of the most complete for a protected area in the Colombian Andes. This information complements previous inventories for this sector of the country (Castaño *et al.* 2003; Castaño Salazar 2012; Acosta Castañeda *et al.* 2014) and becomes a base tool for the formulation of new mammal research and conservation strategies on a regional scale. Furthermore, the genetic characterization performed here for some of the species constitutes a valuable approach to explore mammal richness in Colombia, and particularly within protected areas.

Despite the mammal richness documented for the NNP Selva de Florencia is high (16.30 % of the terrestrial mammals from Colombia; Ramírez-Chaves *et al.* 2020a), many of the small mammal species registered probably require further assessments of their variation, and therefore, of its taxonomic status and distributional limits. For example, both species of genus *Nephelomys* recorded in this study are likely out of the distributional ranges suggested in a recent study based on morphometric and limited genetic data (Cárdenas 2017). Cárdenas (2017) mentioned that for Colombia, *N. childi* is restricted to the Eastern Cordillera, *N. pectoralis* is distributed in the Western Cordillera, and specimens from the Central Cordillera belong to an undescribed



Figure 3. Medium and large mammals registered using camera traps and direct observations in Selva de Florencia. Cingulata: A) *Dasypus novemcinctus*. Pilosa: B) *Tamandua mexicana*. Carnivora: C) *Herpailurus yagouaroundi*. D) *Leopardus pardalis*. E) *Leopardus tigrinus*. F) *Eira barbara*. G) *Nasua nasua*. Artiodactyla: H) *Pecari tajacu*. Rodentia: I) *Syntheosciurus granatensis*. J) *Cuniculus paca*. K) *Dasyprocta punctata*. L) *Dinomys branickii*.

taxon (*Nephelomys* sp.). In contrast, [Percequillo \(2015\)](#) considered that *N. childi* is present in the three Colombian Cordilleras. Therefore, the inclusion of more specimens from both mountain ranges and the north of the Department of Caldas is required to clarify the species inhabiting in this area of Colombia. This implies conducting additional field expeditions, collecting new individuals, and performing a complete molecular characterization. Molecular data (*Cytb*) of some of the species characterized here reflect higher divergence values (ca. 4 %) than those that have traditionally been used to separate sister species in mammals ([Bradley and Baker 2001](#)). This might reflect that a large portion of this diversity surely represents hidden or cryptic diversity (see [Bickford et al. 2007](#)), and in most cases only molecular information (even from a single marker, as Cytochrome b or Cytochrome C Oxidase Subunit 1) might offer enough resolution to detect it ([Bradley and Baker 2001](#)).

In some groups especially, such as rodents, shrews, marsupials, and bats, taxonomy has changed dramatically in recent years with the introduction of molecular data in revisionary works, allowing multiple species to be discriminated from what was once considered a single species (e. g., [Basantes et al. 2020](#); [Voss et al. 2020](#)). Despite that, there are few examples including material from Colombia ([Díaz-Nieto et al. 2016](#); [Franco-Sierra and Díaz-Nieto 2020](#); [Voss et al. 2020](#)), which reflects a delay in the implementation of modern methods for studying mammals in the country. Even though in this work we obtained *Cytb* sequences of common and widely distributed rodent species ([Patton et al. 2015](#)), most of them have been poorly characterized at the genetical level. For instance, our sequence of *C. quichua* is the fourth for the species (second from Colombia) showing intraspecific divergences reaching the range observed between species ([Voss et al. 2013](#)). Similarly, the sequences of *N. tenuipes* are between the first for the species ([Colmenares-Pinzón 2021](#)), and that of *Sigmodontomys alfari* is the fifth for the species (first for Colombia). For *Heteromys* aff. *anomalus* the sequences are the first molecular data from Colombian populations that will be publicly available, and the genetic distances are larger than most of the interspecific values ([Rogers and González 2010](#)). In contrast, for *Sigmodontomys* the distances are within the intraspecific ranges observed for other cricetids (e. g., *Melanomys*; [Hanson and Bradley 2008](#)). In addition, the taxonomy of the rodent species characterized here for the *Cytb* (all rodents) has relied principally on morphology and has remained stable, and none of them have included material collected in protected areas (see [Patton et al. 2015](#)). These efforts must also be replicated for other species of small mammals such as marsupials and shrews, for which cryptic diversity has been observed in Colombia ([Díaz-Nieto et al. 2016](#); [Noguera-Urbano et al. 2019](#)).

The endemic species registered at the NNP Selva de Florencia are typical elements of the Andean region and its inter-Andean valleys and ecoregions (Nor-Andean and Chocó-Magdalena Biogeographic Provinces; [Hernández Camacho](#)

[et al. 1992](#)). Other species documented are more widely distributed in the country and are within the elevational ranges known for the country (see [Solari et al. 2013](#); [Patton et al. 2015](#)). Although the species of mammals recorded in this work were expected at the NNP Selva de Florencia, we highlight the records of the olinguito (*Bassaricyon neblina*), and the Caribbean spiny pocket mouse (*Heteromys* aff. *anomalus*), that were not previously registered for the Department of Caldas ([Castaño Salazar 2012](#)). Of these, the olinguito has been included as the species of Procyonidae with the highest priority and need for research in Colombia ([Andrade-Ponce et al. 2016](#)). In addition, the presence of species in different threaten categories is highlighted, among which, primates have covered the greatest research efforts ([Castaño et al. 2003](#); [Roncancio Duque 2012](#)). Other charismatic and endangered species include felines such as the jaguar (*Panthera onca*) for which its presence has been suggested in the park ([Escobar-Lasso et al. 2014](#)). Finally, for the endemic species, additional analyses integrating biogeographic aspects, molecular information and monitoring plans inside the protected areas are needed due to the limited information available for these taxa ([Noguera-Urbano et al. 2019](#); [Ramírez-Chaves et al. 2020c](#)).

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Appendix 1

Cranial and external measurements (in mm) of the mammals registered in the Selva de Florencia National Natural Park (see materials and methods for the acronyms of the measures we take). M: male; F: female

Didelphimorphia:

Marmosa regina/isthmica (MHN-UCa 1612 M Ad): HBL: 410; LT: 220; HF: 27; LE: 32; Wt: 159; CBL: 44.95; MTR: 17.07; LM: 8.50; PB: 14.32; PL: 24.93; NB: 5.52; LIB: 7.93; LPB: 6.74; ZB: 25.20.

Marmosa sp. (MHN-UCa 876 M Ad): HBL: 462; LT: 255; HF: 25.25; LE: 20.17; Wt: -; CBL: 47.89; MTR: 18.67; LM: 9.13; PB: 12.29; PL: 25.41; NB: 6.85; LIB: 8.7; LPB: 7.48; ZB: 26.81.

Philander melanurus (MHN-UCa 1614 M Ad): HBL: 600; LT: 300; HF: 50; LE: 33; Wt: -; CBL: 71.24; MTR: 29.95; LM: 14.18; PB: 21.51; PL: 42.18; NB: 9.66; LIB: 13.86; LPB: 9.53; ZB: 38.90.

Didelphis marsupialis (MHN-UCa 208 juvenile): HBL: -; LT: -; HF: -; LE: -; Wt: -; CBL: 85.12; MTR: 35.31; LM: 14.93; PB: 26.98; PL: 52.12; NB: 13.46; LIB: 17.53; LPB: 11.40; ZB: 45.77.

Monodelphis adusta (MHN-UCa 263 F Ad): HBL: 100; LT: 37; HF: 12; LE: 10; Wt: 6; CBL: -; MTR: -; LM: -; PB: -; PL: -; NB: -; LIB: -; LPB: -; ZB: -.

Metachirus myosuroides (MHN-UCa 1613M Ad): HBL: 617; LT: 315; HF: 47; LE: 35; Wt: 307; CBL: 59.77; MTR: 24.31; LM: 11.75; PB: 15.42; PL: 32.55; NB: 10.13; LIB: 13.74; LPB: 9.85; ZB: 31.91.

Chiroptera:

Artibeus anderseni (MHN-UCa 1641M): HBL: 45; LT: 0; HF: 8.8; LE: 15.5; FL: 37.6; Wt: 10; GLS: 18.39; CIL: 16.5; CCL: 15.89; LB: 6.05; PB: 4.05; ZB: 10.83; BB: 8.32; MB: 9.53; MTR: 5.9; BM-M: 7.91; BC-C: 5.18.

Artibeus glaucus (MHN-UCa 0172F): HBL: 57; LT: 0; HF: 9; LE: 16; FL: 40; Wt: 15; GLS: 20.08; CIL: 18.07; CCL: 17.31; LB: 5.58; PB: 4.71; ZB: 11.52; BB: 8.89; MB: 10.45; MTR: 6.55; BM-M: 8.18; BC-C: 5.55.

Artibeus bogotensis (MHN-UCa 1642 F): HBL: 52; LT: 0; HF: 7.4; LE: 16.5; FL: 41.8; Wt: 17.5; GLS: 20.69; CIL: 19.93; CCL: 18.16; LB: 6.13; PB: 5.28; ZB: 12.02; BB: 9.28; MB: 10.75; MTR: 6.86; BM-M: 8.74; BC-C: 5.45

Eptesicus andinus (MHN-UCa 0914 F): HBL: 112; LT: 47.3; HF: 9.4; LE: 17; FL: 43.2; Wt: 10; GLS: 16.94; CIL: 16.1; CCL: 15.17; LB: 6.53; PB: 4.29; ZB: 18.82; BB: 7.99; MB: 8.46; MTR: 6.35; BM_M: 6.92; BC-C: 5.03.

Eptesicus chiriquinus (MHN-UCa 0147 F): HBL: 109; LT: 48; HF: 11.4; LE: 15.6; FL: 46.4; Wt: 14; GLS: -; CIL: -; CCL: 15.77; LB: PB: 4.31; ZB: -; BB: -; MB: 9.25; MTR: 6.93; BM_M: 7.65; BC-C: 5.29.

Myotis caucensis (MHN-UCa 0050 M): HBL: 81.7; LT: 40.2; HF: 7.3; LE: 13; FL: 37.3; Wt: 5; GLS: 14.29; CIL: 13.73; CCL: 12.79; LB: 3.88; PB: 3.72; ZB: -; BB: 6.55; MB: 7.15; MTR: 5.7; BM_M: 6.15; BC-C: 3.85.

Myotis keasyi (MHN-UCa 1659 F): HBL: 85; LT: 38; HF: 6; LE: 12; FL: 38.9; Wt: 6; GLS: 14.01; CIL: 13.47; CCL: 12.62; LB: 4.19; PB: 3.64; ZB: 9.23; BB: 6.51; MB: 7.26; MTR: 5.43; BM_M: 5.69; BC-C: 3.72.

Myotis riparius (MHN-UCa 1658 F): HBL: 83; LT: 38; HF: 8; LE: 15; FL: 36; Wt: 5; GLS: 13.49; CIL: 13.17; CCL: 12.03; LB: 3.92; PB: 3.62; ZB: 8.62; BB: 6.97; MB: 7.03; MTR: 5.13; BM_M: 5.75; BC-C: 3.83. (MHN-UCa 1657 M): HBL: 84; LT: 43; HF: 6.8; LE: 14; FL: 39.1; Wt: 6; GLS: 13.98; CIL: 13.76; CCL: 12.61; LB: 3.53; PB: 3.36; ZB: 8.61; BB: 6.33; MB: 7.03; MTR: 6.16; BM_M: 5.79; BC-C: 3.81.

Carnivora:

Cerdocyon thous (MHN-UCa 200): CBL: 126.13; BB: 45.33; LIB: 24.14; LPB: 32.15; BR: 20.69; ZB: 69.4.

Leopardus tigrinus (MHN-UCa 205): CBL: 85.24; BB: 37.56; LIB: 15.5; LPB: 23.15; BR: 19.99; ZB: 51.6.

Bassaricyon neblina (MHN-UCa 1631 F): CBL: 74.39; BB: 34.68; LIB: 15.93; LPB: 17.4; BR: 16.1; ZB: 46.05.

Rodentia: Values are the observed range (in parentheses) and the mean.

Handleyomys alfaroi (n= 2 M): HBL: (212-244) 228; LT: (106-127) 116.5; HF: (25-28) 26.5; LE: 17 -; CIL: (23.14-26.7) 24.92; LD: (6.43-7.82) 7.13; LM: (3.58-4.1) 3.84; BM1: (1.15-1.24) 1.195; LIF: (4.56-5.18) 4.87; BIF: (2.08-2.72) 2.4; PB: (2.61-3.48) 3.05; BZP: (2.65-3.09) 2.87; ZB: (12.74-15.39) 14.07; LIB: (4.8-5.43) 5.12; NL: (10.39-11.62) 11.01; IPB: (10.63-11.25) 10.94.

Handleyomys alfaroi (n= 5 F): HBL: (215-230) 220.6; LT: (105-119) 111; HF: (25-28) 26; LE: (16-18) 17; CIL: (23.03-25.12) 24.26; LD: (6.26-7.09) 6.7; LM: (3.74-3.87) 3.83; BM1: (1.07-1.19) 1.15; LIF: (4.18-4.9) 4.5; BIF: (2.13-2.39) 2.29; PB: (2.71-2.93) 2.81; BZP: (2.66-3.07) 2.86; ZB: (13.14-13.69) 13.46; LIB: (4.9-5.53) 5.12; NL: (10.73-11.78) 11.16; IPB: (10.48-11.11) 10.92.

Transandinomys talamancae (n= 2 M): HBL: (184-264) 224; LT: (94-127) 110.5; HF: (26-29) 27.5; LE: 17; CIL: 23.18; LD: (6.37-8.27) 7.32; LM: (4.49-4.58) 4.535; BM1: 1.33; LIF: (3.49-4.43) 3.96; BIF: (1.83-1.88) 1.855; PB: (2.5-3.14) 2.82; BZP: (2.58-3.43) 3.01; ZB: 13.26; LIB: (5.08-5.34) 5.21; NL: (10.01-11.99) 11; IPB: 11.12.

Melanomys caliginosus (n= 4 F): HBL: (197-243) 217.5; LT: (85-108) 93.75; HF: (26-28) 27; LE: (16-15) 15.75; CIL: (24.51-28.02) 26.27; LD: (6.41-7.62) 7.095; LM: (3.97-4.81) 4.6; BM1: (1.18-1.51) 1.36; LIF: (3.85-4.6) 4.375; BIF: (1.78-2.25) 1.97; PB: (2.87-3.21) 3.01; BZP: (2.55-3.12) 2.86; ZB: (13.68-16.14) 15.25; LIB: (4.82-6.23) 5.74; NL: (10.2- 12.12) 11.56; IPB: (11.48-12)

21.77. (n= 3 M): HBL: (200-216) 206.6; LT: (85-95) 88.67; HF: (26-27) 26.33; LE: (15-16) 15.67; CIL: (24.23-27.44) 25.93; LD: (6.39-7.46) 6.926; LM: (4.52-4.77) 4.58; BM1: (1.39-1.44) 1.41; LIF: (3.5-4.68) 4.26; BIF: (1.63-1.83) 1.74; PB: (2.5-2.87) 2.65; BZP: (2.31-2.83) 2.65; ZB: (14.57-15.78) 15.19; LIB: (5.93-6.12) 6.02; NL: (10.70-10.74) 10.60; IPB: (11.61-12.1) 11.87.

Tylomys mirae (FMNH 71215 M): HBL: 477; LT: 229; HF: 40; LE: 29; CIL: 47.54; LD: 14.04; LM: 8.73; BM1: 2.23; LIF: 8.82; BIF: 3.76; PB: 4.61; BZP: 8.23; ZB: 26.14; LIB: 10.90; NL: 17.0; IPB: 17.33.

Nectomys magdalenae (MHN-UCa 1448 M): HBL: 500; LT: 242; HF: 48; LE: 15.87; CIL: 42.62; LD: 12.38; LM: 7.08; BM1: 2.13; LIF: 6.74; BIF: 3.43; PB: 4.97; BZP: 5.26; ZB: 24.57; LIB: 7.44; NL: 18.59; IPB: 8.91.

Neacomys tenuipes (MHN-UCa 1627, 1628, 1692 F) HBL: 157; LT: 85; HF: 18; LE: 14; CIL: 18.42; LD: 5.16; LM: 2.68; BM1: 0.79; LIF: 2.47; BIF: 1.62; PB: 2.41; BZP: 1.73; ZB: 10.06; LIB: 4.17; NL: 8.6; IPB: 7.79. (2n= M) HBL: (160-166.22) 163.11; LT: (87-91.3) 89.15; HF: (20.3-21) 20.65; LE: 15.6; CIL: (18.17-19.58) 18.88; LD: (5.2-5.89) 5.545; LM: (2.268-2.85) 2.56; BM1: (0.91-0.92) 0.92; LIF: (2.41-2.47) 2.44; BIF: (1.61-1.48) 1.55; PB: (2.34-2.63) 2.49; BZP: (1.68-1.86) 1.77; ZB: 11.33; LIB: (4.26-4.41) 4.36; NL: (8.7-8.87) 8.79; IPB: (8.03-8.37) 8.20.

Sigmodontomys alfari (MHN_UCa 1630 M): HBL: 280; LT: 155; HF: 31; LE: 17; CIL: 31.58; LD: 9.59; LM: 5.52; BM1: 1.85; LIF: 4.9; BIF: 2.32; PB: 3.09; BZP: 4.23; ZB: 17.64; LIB: 6; NL: 14.43; IPB: 7.73.

Heteromys aff. anomalus (n= 4 M): HBL: (196-265) 232.25; LT: (110-145) 132.50; HF: (28.6-33) 30.20; LE: (13.5-19) 16.13; CIL: (23.25-29.02) 26.59; LD: (7.11-9.06) 8.18; LM: (4.08-5.07) 4.71; BM1: (1.4-1.72) 1.52; LIF: (1.6-1.9) 1.76; BIF: (0.91-0.95) 0.93; PB: (1.67-2.62) 2.18; BZP: (3.29-3.72) 3.45; ZB: (15.13-16.79) 15.86; LIB: (7.27-9.07) 8.47; NL: (12.65-13.97) 13.29; IPB: (7.63-8.49) 8.12. (F): HBL: 242; LT: 147; HF: 33.1; LE: 17; CIL: 27.66; LD: 8.45; LM: 4.69; BM1: 1.59; LIF: 1.63; BIF: 0.93; PB: 2.61; BZP: 3.46; ZB: 15.02; LIB: 8.96; NL: 13.52; IPB: 7.75.

Nephelomys pectoralis (MHN-UCa 185 F, 190 F): HBL: (300-335) 317.5; LT: (162-190) 117.6; HF: (34.3-36.7) 35.5; LE: (21-22.4) 21.7; CIL: (32.65-35.53) 34.09; LD: (9.78-10.48) 10.13; LM: (5.29-5.84) 5.57; BM1: (1.63-1.67) 1.65; LIF: (6.27-6.77) 6.52; BIF: (2.97-2.98) 2.98; PB: (3.82-3.85) 3.84; BZP: (3.87-3.96) 3.92; ZB: (17.22-19.63) 18.43; LIB: (4.97-5.36) 5.17; NL: (13.25-14.64) 13.95; IPB: (9.4-10.78) 10.09. (MHN-UCa 188 M): HBL: 300; LT: 160; HF: 33.1; LE: 21.1; CIL: 31.01; LD: 9.12; LM: 5.54; BM1: 1.57; LIF: 6.4; BIF: 2.99; PB: 3.69; BZP: 3.77; ZB: 17.12; LIB: 5; NL: 11.94; IPB: 9.25.

Nephelomys childi (MHN-UCa 772 M): HBL: 290.7; LT: 140; HF: 33.45; LE: 21.95; CIL: 31.49; LD: 9.44; LM: 5.33; BM1: 1.51; LIF: 5.37; BIF: 2.56; PB: 3.71; BZP: 3.7; ZB: 17.27; LIB: 5.57; NL: 12.29; IPB: 9.61.

