

# First sympatric records of Coatis (*Nasuella olivacea* and *Nasua nasua*; Carnivora: Procyonidae) from Colombia

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## Abstract.

Coatis are among the most unknown small carnivore species in Colombia; even when all coati species have wide distributions, still many aspects of their ecology still need to be explored. Here we present the first confirmed records of sympatry between *Nasua nasua* and *Nasuella olivacea* for Colombia and their entire range. Using camera traps at different distances from Chingaza National Natural Park between August and November 2015 (1,367 trap-nights), we obtained four records for *N. nasua* and two records for *N. olivacea*, with one locality shared by both species. So far, no confirmed records existed for two sympatric coati species, and all were considered to have disjunctive, non-overlapping distributions. This finding opens a wide range of new ecological questions, in order to understand how this species compete or share the same habitats, and the underlying traits and process that allow this type of sympatric distributions. We expect that with the growing number of field research efforts, especially with camera-traps, new information will be available about the ecology of both species and likely new localities will record both species using the same spaces.

**Keywords:** Andes, Cundinamarca, Mountain Coati, South American Coati, sympatry

## Resumen.

Los cusumbos están entre las especies menos conocidas en Colombia; incluso cuando todos los cusumbos tienen amplias distribuciones en el continente, todavía muchos aspectos de su ecología requieren ser explorados. Presentamos los primeros registros de simpatria entre *Nasua nasua* y *Nasuella olivacea* para Colombia y todo su rango de distribución. Por medio de cámaras-trampa a diferentes distancias del Parque Nacional Natural Chingaza, entre agosto y noviembre de 2015 (1,367 noches-trampa) obtuvimos cuatro registros de *N. nasua* y dos registros de *N. olivacea*, con una localidad compartida por ambas especies. Hasta ahora, no existían registros confirmados de dos especies de Coati simpátricos, y todos eran considerados con distribuciones disyuntas y no sobrepuestas. Este hallazgo abre un amplio rango de preguntas ecológicas nuevas, con el fin de entender cómo las especies compiten o comparten el hábitat y los procesos y caracteres subyacentes que permiten este tipo de distribuciones simpátricas. Esperamos que con el creciente número de esfuerzos de campo, especialmente con cámaras trampa, nueva información estará disponible sobre la ecológica de ambas especies y es esperable que surjan nuevas localidades de registro de ambas especies usando los mismo espacios.

**Palabras clave:** Andes, Cundinamarca, Cusumbo de montaña, Cusumbo rojo, simpatria

## Introduction

Coatis, genera *Nasua* and *Nasuella* (Procyonidae), are among the most unknown small carnivore species in Colombia and the Americas, with only information regarding distribution records but few ecological or natural history information (Balaguera-Reina *et al.* 2009, González-Maya *et al.* 2011a, Suárez-Castro & Ramírez-Chaves 2015). For Colombia even information regarding presence in the country was uncertain for some

species (*i.e.*, *Nasua narica*; González-Maya *et al.* 2011b), and recent taxonomic and phylogenetic analyses have provided with updated, yet based on few records, distribution of some of the species for the country (*e.g.*, *Nasuella olivacea*; Helgen *et al.* 2009). Coatis have presumably wide distributions both at continent and Colombia-level, with three species confirmed for the country (*i.e.*, *Nasua nasua*, *N. narica* and *Nasuella olivacea*; Solari *et al.* 2013) and one potentially present yet not confirmed with specimens but only recent observations (*i.e.*, *Nasuella meridensis*; Vela-Vargas unpub. data). In general, most species are considered as ecologically similar, and current information suggests all species have disjunct, allopatric distributions in the country, with all species reaching the limits of their respective ranges in the country, and most of them conspicuous representatives of different ecosystems (Suárez-Castro & Ramírez-Chaves 2015). Considering the wide range of habitats, considerably large ranges and certain tolerance to intervention (Emmons & Helgen 2008, Reid & Helgen 2008, Samudio *et al.* 2008), and overlapping elevation range for all species, it is likely some overlapping areas could occur where at least two of them could potentially be sympatric; however, so far, no information exists regarding two Coati species using the same habitats. Here we present the first records of sympatric Coatis, *Nasuella olivacea* and *Nasua nasua*, for Colombia, and to our knowledge of the continent, derived from field records with camera-traps in the eastern Andean mountain range, Guavio region, nearby Bogota, capital city of Colombia.

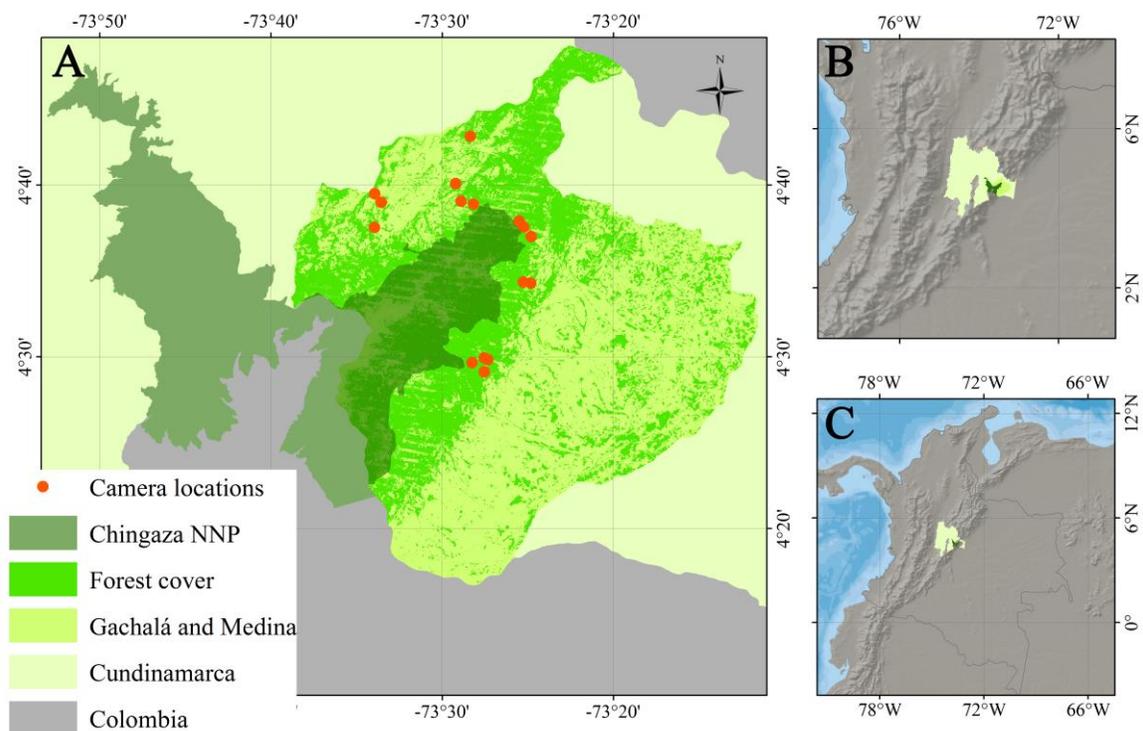
## Materials and methods

### *Study area*

Our field site is located approximately 68 km from Bogotá, within the Guavio region in the Cundinamarca department (province), located in the eastern range of the Andes (Figure 1). Specifically our study covered the Medina and Gachalá municipalities within the Cundinamarca department, and under the jurisdiction of the Corporación Autónoma Regional del Guavio (CORPOGUAVIO; regional environmental authority), in the buffer zone of Chingaza National Natural Park (Chingaza NNP). The area is considered a unique biodiversity region given that includes a significant proportion of Andean and Piedmont ecosystems, and a large elevation gradient from Paramo areas around 4,500 m asl down to 300 m asl on the Llanos piedmont (Vela-Vargas *et al.* 2015). The region has suffered a significant land-use change and habitat loss due mainly to the expansion of the agricultural and cattle frontier expansion, interventions derived from a dam construction (Guavio dam), currently retaining approximately only 22% of its territory under natural forest covers (Vela-Vargas *et al.* 2015). Nevertheless, current efforts for conservation planning in the region are focusing on generating functional connectivity between Chingaza NNP and surrounding areas, both by creating regional protected areas and functional landscapes through co-benefit programs with local communities (Vela-Vargas *et al.* 2015).

## Methods

A camera-trapping systematic survey was designed in order to estimate the influence of landscape variables and current limitations for habitat connectivity for carnivore species along the jurisdiction of CORPOGUAVIO, including Chingaza NNP as a potential source for carnivore populations (Vela-Vargas *et al.* 2015). The design included a total of 16 camera-traps (Bushnell Trophy Cam) located on different forest patches at different buffer distances from Chingaza NNP (2, 4, 6 and 8 km), covering an elevation from 1,275 to 2,491 m asl, all located within the transition between Clouded Andean forests and Paramo ecosystems. The cameras were established on random locations selected within each treatment and within potential connection routes between Chingaza NNP and surrounding areas north of the park. All cameras were located on existing animal trails at 30 cm above ground and configured for three photos, delay of 10 second and active during the 24h day cycle; we considered independent records those with at least 1 h difference (González-Maya *et al.* 2009). We estimated the proportion of forested habitats within the habitat context by estimating forest cover within a 5 km buffer of the camera location and based on the national land-cover layer (IGAC 2010).



**Figure 1.** (A) Location of cameras and study area in the context of the (B) Eastern Andes range and (C) Colombia for carnivore connectivity in Guavio region, Colombia.

## Results

A total of 1,367 trap-nights sampling effort was held between August and November 2015, obtaining 351 positive events of 18 different mammal species, distributed in six orders. Nine carnivore species were detected, including four felid species (*Puma concolor*, *Leopardus pardalis*, *L. wiedii* and *L. tigrinus*), two mustelids (*Eira barbara* and *Galictis vittata*), one mephitid (*Conepatus semistriatus*) and two procyonids (*Nasuella olivacea* and *Nasua nasua*). From these, only one carnivore species is considered under a threat category by the IUCN Red List of Threatened Species (IUCN 2014; *L. tigrinus*: Vulnerable; de Oliveira *et al.* 2008), one Data Deficient (*N. olivacea*; Reid & Helgen 2008), and the rest are considered as Least Concern (IUCN 2014). In total, we obtained six positive events of Coatis in four localities, four pictures of *Nasua nasua* and two pictures of *Nasuella olivacea*, all located between 2 and 4 km buffers from Chingaza NNP and in both municipalities. We also include three records of *N. olivacea* obtained during 2014 on a similar project in the same area only for future reference.

All Coati records were obtained between September and November 2015, with the first record for *N. olivacea* obtained on 17 September and located at Periquito locality, and the first record for *N. nasua* obtained on 7 October and located at Gachalá locality (Table 1). Even when both species potentially occur in sympatry along the study region, the only confirmed sympatric records of both species at the same site were obtained at Periquito locality, Medina municipality (4.49903 N, 73.45867 W) at 1,934 m asl, with the record for *N. olivacea* obtained on 17 November and the record for *N. nasua* on 9 November (Table 1, Figure 2).

**Table 1.** Records of *Nasua nasua* and *Nasuella olivacea* in Guavio region, Colombia, with the first confirmed sympatric record for the country (\*).

Species	No. of records	Date	Time	Locality	Municipality	Coordinates	Elevation (m asl)	Habitat
<i>N. nasua</i>	1	9Nov2015	13h24	Periquito	Medina*	4.49903 N 73.45867 W	1,934	Dense Natural Forest
	2	11Nov2015 6Nov2015	11h13 19h33	Gachalá	Gachalá	4.49407 N 73.47065 W	1,539	Dense Natural Forest
	1	7Oct2015	10h15	Gachalá	Gachalá	04.66814 N 73.48663 W	1,824	Shrubland
<i>N. olivacea</i>	1	17Nov2015	13h22	Periquito	Medina*	4.49903 N 73.45867 W	1,934	Dense Natural Forest
	1	17Sep2015	5h04	Gachalá	Gachalá	4.64804 N 73.4693 W	2,381	Dense Natural Forest
	1	24Dec2014	00h15	Cerro Ají	Ubalá	4.77525 N 73.54744 W	2,729	Dense Natural Forest
	2	7Dec2014 7Dec2014	9h34 17h49	Las Delicias	Ubalá	4.79793 N 73.54341 W	3,090	Dense Natural Forest
	1	7Dec2014	4h51	Cerro Ají	Ubalá	4.77608 N 73.54684 W	2,728	Dense Natural Forest

Other species detected at the same site include the Mountain Paca *Cuniculus taczanowskii*, Red-tailed Squirrel *Sciurus granatensis*, Tayra *Eira barbara*, Puma *Puma concolor* and Ocelot *Leopardus pardalis*. Capture frequencies (pictures/sampling effort)

was similar for all species, with *E. barbara* and *L. pardalis* been the species most detected on the site (0.0029 pictures/trap-night). Domestic dogs *Canis familiaris* were detected in two of the three localities where *N. nasua* was detected, and where not captured at any of the two sites where *N. olivacea* occurred. Interestingly, the site where both species were detected has the highest proportion of forested habitat within the buffer (89.2%), while the mean proportion ( $\pm$  SD) of forest for all sites with Coati detections was  $58.9 \pm 31.6\%$  ( $64.6 \pm 36.1\%$  for *N. nasua* and  $61.6 \pm 28.1\%$  for *N. olivacea*) and without Coati  $69.7 \pm 21.2\%$ . Mean distance of camera-traps with coati detections to rivers and roads ( $\pm$  SD) was  $664.1 \pm 458.0$  and  $4,103.4 \pm 1,706.2$  m, respectively (*N. nasua*: rivers =  $871.8 \pm 235.8$  m, roads =  $4,334.3 \pm 2,011.5$ ; *N. olivacea*: rivers =  $341.6 \pm 425.65$ , roads =  $4,348.0 \pm 1,325.9$ ) and  $667.92 \pm 472.13$  and  $3,950.3 \pm 2,138.8$  m for rivers and roads in non-coati sites, respectively.



**Figure 2.** Sympatric record obtained through pictures from camera-traps of (A) *Nasuella olivacea* and (B) *Nasua nasua* in Guavio region, Cundinamarca department, Colombia.

## Discussion

We found previous accounts that claim to have sympatric records of both species, also for the Andean region, but do not provide details or extensive accounts on the presence of both species at the same site or specifically in sympatricity (Sánchez *et al.* 2004, 2008, Delgado-V 2009, Ramírez-Mejía & Sánchez 2015), and most of them have not confirmed presence for at least one of the species (*e.g.*, based on tracks, observations, etc.). Nevertheless, considering Colombia is one of the only countries where sympatric coati species could occur, these previous records or inferences indicate that potentially other areas could represent areas of potential range overlapping among coatis, all of them in the Andes. *Nasua nasua* is considered to be distributed across most of South America (Samudio *et al.* 2008), and for Colombia is considered to be distributed in the Amazon, Andes and Orinoco regions between 0 and 3,600 m asl (Solari *et al.* 2013); *N. olivacea* is distributed in Colombia, potentially Peru and Ecuador (Helgen *et al.* 2009) and in Colombia is reported for the Andean region and Serranía del Perijá between 1,700 and 4,100 m asl (Solari *et al.*

2013). Even when both distributions overlap significantly, so far no records of both species occupying the same habitats have been obtained or confirmed. The third confirmed species, *Nasua narica*, is only confirmed for the Pacific region, having the southernmost limit of its distribution in Colombia (González-Maya *et al.* 2011), therefore, there are currently no areas, based on current knowledge, that any of the other two species share with *N. narica* in the country, nor across their distribution.

Ecologically, both species have similar requirements, with *N. nasua* having a significant wider ecological plasticity, occupying a considerable larger number of habitats (Suárez-Castro & Ramírez-Chaves 2015); *N. olivacea* is restricted to the Andes, mostly associated with high-Andean forests and the lower limits of Paramos (Rodríguez-Bolaños *et al.* 2000, Rodríguez-Bolaños *et al.* 2003, Balaguera-Reina *et al.* 2009). Few information exists regarding foraging and diet (Rodríguez-Bolaños *et al.* 2000), but it seems both species share similar traits and dietary compositions (Rodríguez-Bolaños *et al.* 2000, Beisiegel 2001, Rodríguez-Bolaños *et al.* 2003, Alves-Costa *et al.* 2004, Suárez-Castro & Ramírez-Chaves 2015). It is not clear how both species can share or compete within the same habitat, and our records, even when few, do not seem to reflect any differential time-use within the same habitat. Further research is needed in order to better understand how both species can share the same habitat or if competition exists for resources or space. This finding opens a wide range of ecological questions that we expect will promote to further explore the ecology of both species and their functional role in Andean ecosystems.

The significant increase of camera-trap efforts across the continent, and especially in Colombia, are providing a large number of records for both species, but still, both are still considered as neglected species with few studies focused on assessing their status, ecology or distribution, or with valuable information never published or considered (Schipper *et al.* 2009, González-Maya *et al.* 2011). Furthermore, for Colombia, social conflict and general civil violence across the country prevented many areas to be properly studied or explored and is not until recently that a significant number of studies are focusing on filling the geographic and taxonomic gaps, which in a few years will allow drawing better inferences regarding the distribution of most medium and large size mammals, especially carnivores, in the country. It is expected that in coming years similar records like the one presented herein will be available from research efforts across the country; nevertheless, this record provides valuable information for starting to better understand the ecology and importance of mesocarnivores in tropical ecosystems, especially on the sight of more dramatic and larger disturbances in most ecosystems across the country.

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