ANALYSIS REPORT ON PHOTODETECTION
AT THE MOUTH OF CAÑO MONOS
RESGURADO INDÍGENA UNIFICADO SELVA DE MATAVÉN
VICHADA – COLOMBIA

This study was conducted within the framework of the REDD+ Matavén Project

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1. INTRODUCTION

The development of human society and its related activities have led to significant modifications in the landscape through the loss and fragmentation of natural habitats. Often, attention is focused on agricultural activities, where the expansion of productive systems has rapidly encroached upon surrounding habitats, diminishing them and limiting connectivity between the remaining habitat patches (Bourgoin et al., 2021). In this context, biological monitoring becomes crucial for identifying the impact of these activities on wildlife populations. Various ecological variables can serve as indicators in a monitoring program, such as distribution, abundance, occupancy, and density, among others. However, it is essential that the selected variables are influenced by anthropogenic impacts. Additionally, the species selected, and the sampling method implemented must be appropriate for obtaining information on the chosen ecological variables. This approach allows for determining whether human activities in the area negatively, positively, or neutrally affect the ecosystem.

Among fauna groups, mammals exhibit a wide range of habits, sizes, and trophic guilds, making them informative at different spatial scales (Feldhamer et al., 2007). Medium and large mammals, particularly carnivores, are often more informative for detecting ecosystem changes because they require larger home ranges to establish their territories (Granizo et al., 2006). However, direct observations of these species in forested areas can be challenging due to their elusive behavior (Tobler et al., 2008). Consequently, non-invasive sampling strategies have been implemented to gather information about species without needing direct observation or manipulation. One of the most commonly used methodologies for monitoring medium and large mammals is the deployment of automatic detection cameras (Moreno, 2001).

The region known as the Matavén Forest is considered a transition zone between the vast Amazon rainforests and the extensive savannas of the Orinoquía. It holds special biological interest not only due to its biogeographical position but also because of its good conservation status, with less than 5% of its total area converted into cultivation and fallow lands (Villareal et al., 2009). In the Vichada department, 124 mammal species have been recorded (S. Solari et al., 2013), representing 23% of the country's mammalian diversity. Multiple efforts have been made to document the biodiversity at the mouth of the Matavén Stream, also known as Caño Monos, where the Piaroa communities of Pueblo Nuevo, La Urbana, Piedra Pintada, and Sarrapia are located. These communities possess both ancestral and current knowledge of their biodiversity, which has facilitated the development of activities such as sport and ornamental fishing. This analysis aims to conduct a study focused on recording mammals using automatic detection cameras, contributing to the knowledge of this important group at the mouth of Caño Monos in the Matavén Forest.

2. METHODOLOGY

Design: The study aims to record terrestrial mammal species in the area influenced by the mouth of the Matavén Stream, encompassing the Piaroa communities of La Urbana, Piedra Pintada, and Pueblo Nuevo in the Vichada department, Colombia. From December 1st to 9th, 2022, 17 automatic cameras were installed at individual stations randomly within this matrix. The cameras were placed to create a radius ranging from 500 meters to 1 kilometer between each station, ensuring the independence of each record, as suggested for several large mammal species (Payán & Soto, 2012) (Figure 1 and Table 1). Each camera remained active until February 10th, 2023.

Figure 1: *Location of sampling stations at the mouth of the Matavén Stream*

Table 1: *Geographic location and type of coverage analyzed by sampling station*

Station	Latitude	Longitude	Type of Coverage
1	4.49005	-67.91699	Secondary Forest
2	4.49236	-67.91305	Flooded Primary Forest
3	4.49652	-67.9108	Secondary Forest
4	4.50059	-67.90816	Secondary Forest
5	4.50385	-67.90497	Secondary Forest
6	4.50077	-67.9176	Secondary Forest
7	4.50784	-67.92416	Savanna and Secondary Forest
8	4.55649	-67.90446	Savanna - Flooded Primary Forest
9	4.56091	-67.90398	Flooded Primary Forest
10	4.57913	-67.87218	Flooded Primary Forest
11	4.57249	-67.87591	Flooded Primary Forest
12	4.56578	-67.87886	Flooded Primary Forest
13	4.56224	-67.87666	Flooded Primary Forest

Station	Latitude	Longitude	Type of Coverage
14	4.53994	-67.86709	Regenerating Vegetation
15	4.53603	-67.86769	Rocky Hill
16	4.56994	-67.91703	Regenerating Vegetation
17	4.55862	-67.9223	Flooded Savanna

Installation: The cameras were placed in locations that appeared to be transit routes for these species, including paths or forest edges, to maximize the probability of capture. The installation criteria included characteristics such as traces (footprints, burrows, wallows, feces, etc.) and any other evidence of mammals in the area (Maffei et al., 2002). At no point were attractants used with the cameras (Figure 2). Each camera was attached to a tree at a height of approximately 30 cm from the ground.

Figure 2: *Installation of automatic cameras and evidence of mammal traces at various sampling points*

Programming: The cameras were programmed with high-quality resolution, 5 MP, and an active day/night sensor, capturing 15-second video clips. Each capture episode was considered a continuous sampling period of one day, thus defining discrete time units (Delgado-V et al., 2011). The cameras were set with a 10-second interval, high PIR sensitivity, 15-second video length, three photos per trigger, HD video quality, and included data on temperature, date, and time. Each individual record was separated from the next using a one-hour criterion.

In addition to the camera trapping, direct observations were conducted through daytime and nighttime surveys to directly observe various species and indirectly search for tracks and signs (feces, hair, burrows, wallows, etc.). These active search walks were performed alongside other activities, focusing on identifying any evidence of mammals in the area. As part of the indirect detection method, informal interviews were conducted with local residents and project workers, preferably older individuals with considerable time spent in the area. Graphic materials with illustrations of Neotropical mammals were used to aid residents in identifying the mammals (Figure 3) (Cuartas-Calle & Marín-C, 2014; Emmons, 1999; Tirira, 2007). However, these data were used to supplement the mammal list and not for further analysis.

Figure 3: *Schematics with illustrations and photographs used in informal interviews*

2.1. Data Treatment

To assess the current mammalian composition, an analysis was conducted comparing the richness and relative abundance of the recorded species. These data were contrasted with the list of mammal species reported for the area (Osorno-Muñoz et al., 2019). Relative abundance was calculated based on the total abundance recorded for each species. Sampling effort and capture success were calculated to standardize the methodology for assessing the faunal richness of a region more efficiently. These metrics are also key in developing species accumulation curves.

For automatic cameras, the number of cameras and the hours they were active were considered. Capture success is estimated as the total number of individuals captured divided by the effort and is expressed as a percentage (Gómez-Laverde, 1993; Jayat & Ortiz, 2010; Wilson et al., 1996). Table 3 shows the capture efforts used, distributed by sampling site. For automatic cameras, the effort was 1164 camera/days, differentially distributed for each site, determined by the time they were active. For the sighting methodology, an extrapolation of effort in time was made during other activities, amounting to 8 hours/observer. However, subsequent analyses included records from multiple observers, so sampling success was not calculated for this methodology.

2.2. Sampling Representativeness

To evaluate the sampling effort in relation to the proportion of species recorded in the area, two indicators were employed: the species accumulation curve and sample coverage. The species accumulation curve indicates the rate at which new species are added as sampling effort increases, eventually reaching an asymptote representing the total species present in the area (Ugland et al., 2003). On the other hand, sample coverage assesses the completeness of the sampling by measuring the proportion of the total number of individuals that belong to the species detected in the sample (Hsieh et al., 2016). These indicators were calculated for the entire study area. The INext package (Hsieh et al., 2016) in R (R Core Team, 2019) was used for these calculations.

2.3. Analysis of Diversity and Community Structure

Alpha Diversity

The community structure was evaluated based on dominance and evenness. Dominance was measured using the Simpson Index, which calculates the probability that two randomly selected individuals belong to the same species (Díaz-Pulido et al., 2015). Evenness was measured using the Shannon-Wiener Index, which calculates the probability that all species are represented in a randomly taken sample (Moreno et al., 2011). These alpha diversity indices were calculated using the 'vegan' package (Oksanen et al., 2017).

Beta Diversity

The differences in diversity between different monitoring points were measured using the homogenization indicator with the Jaccard Index (I_j) (Moreno et al., 2011). These indices were calculated using the 'vegan' package (Oksanen et al., 2017), considering only presence/absence data. The function calculates the indices based on Bray-Curtis dissimilarity (Bray & Curtis, 1957), so the results of these indices are interpreted as dissimilarity between the sampled areas (1 - similarity).

2.4. Functional Guilds and Ecological Diversity

Functional diversity quantifies the value and range of species' functional traits that affect ecosystem processes (Xu et al., 2018). It can be used to compare the number of ecological functions present in a conserved area or reference habitat with areas that have undergone land-use changes. This comparison aids in proposing new strategies for management and conservation plans (Magioli et al., 2016). For mammals, diet type and mode of locomotion were selected as functional traits. These traits have been considered in other studies to calculate the functional diversity of mammals (Barr & Biernat, 2020).

The categories of trophic guilds were established by modifying the classification proposed by Tirira (2007) and modifications by Robinson & Redford (1986), Linares (1987), and Kalko et al. (2008), which include characteristics such as feeding habits and diet in the following categories:

1. Omnivores: Species that have two or more different types of diets, with none predominating over the others.
2. Carnivores: Diet based on meat, including:
    - Insectivores: Diet based on insects.
    - Piscivores: Diet based on fish.
3. Herbivores: Primarily plant-based diet, including:
    - Nectarivores: Diet based on nectar and/or pollen.
    - Frugivores: Diet based on fruits.
    - Frugivore-Folivores: Diet based on fruits and leaves.
    - Folivore-Granivores: Diet based on leaves and seeds.
    - Granivores: Diet based on seeds.
4. Hematophages: Diet based on vertebrate blood, such as from mammals and birds.

2.5. Species of special interest, their use, and cultural valuation

The determination of threat categories and endemism took into account Resolution 192 of February 10, 2017, established by the Ministry of Environment and Sustainable Development (MADS, 2017), which lists threatened wildlife species for the national territory. Additionally, threat categories from the IUCN Red List of Threatened Species (www.iucnredlist.org, 2023), the Red List of Mammals of Colombia (Rodriguez-Mahecha et al., 2006), and Appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, 2017) were considered.

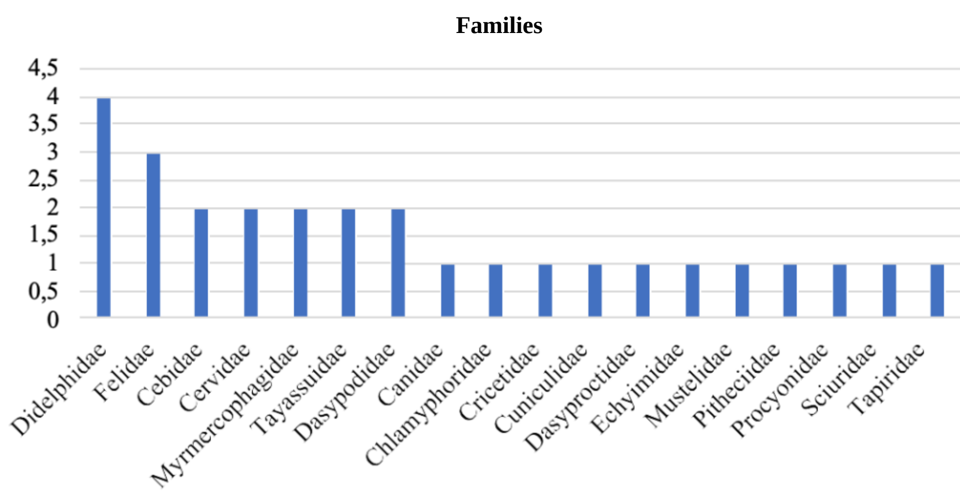
3. RESULTS

3.1. Taxonomic composition (richness, composition, structure)

A total of 349 records were obtained using the automatic camera methodology. Twenty-eight species were reported (24 from cameras and 4 from sightings), belonging to 19 families and eight orders (Table 2). The order with the highest richness was Carnivora, with 21.43% of the species, followed by Rodentia (17.86%) and Artiodactyla (14.29%) (Figure 4A). The most represented family in the sampling was the opossums, with 14.9% of the recorded species, followed by felines (10.71%). Monkeys, deer, anteaters, peccaries, and armadillos each contributed 7.14% to the family richness (Figure 4B).

Figure 4. *Mammal richness recorded at photodetection stations at the mouth of Caño Monos – Matavén Forest A. Orders B. Families*

A.



B.

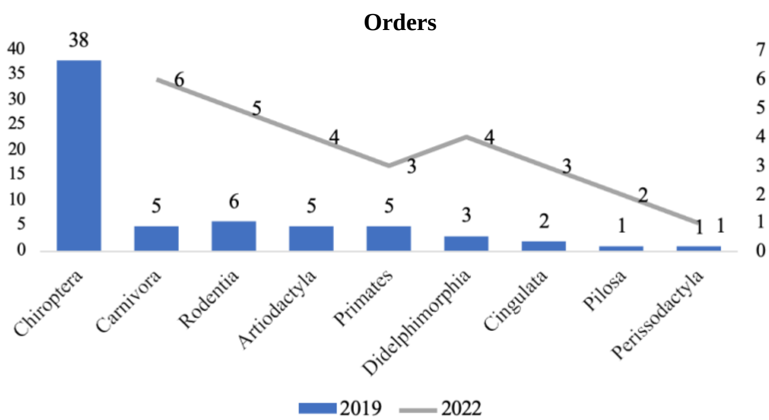
Table 2: *Mammal species reported at photodetection stations at the mouth of Caño Monos – Matavén Forest*

Trophic Categories: (N) Nectarivore, (G) Granivore, (Fl) Folivore, (F-Fl) Frugivore-Folivore, (F-G) Frugivore-Granivore, (F) Frugivore, (C) Carnivore, (O) Omnivore, (I) Insectivore. **Locomotion:** (A) Arboreal, (T) Terrestrial, (SA) Semi-aquatic, (F) Fossorial, (AS) Sub-canopy aerial, (AD) Canopy aerial, (ES) Scansorial. **Type of Record:** (A) Sighting (including traces, burrows, etc.), (CA) Automatic Camera. **NC:** Not Categorized.

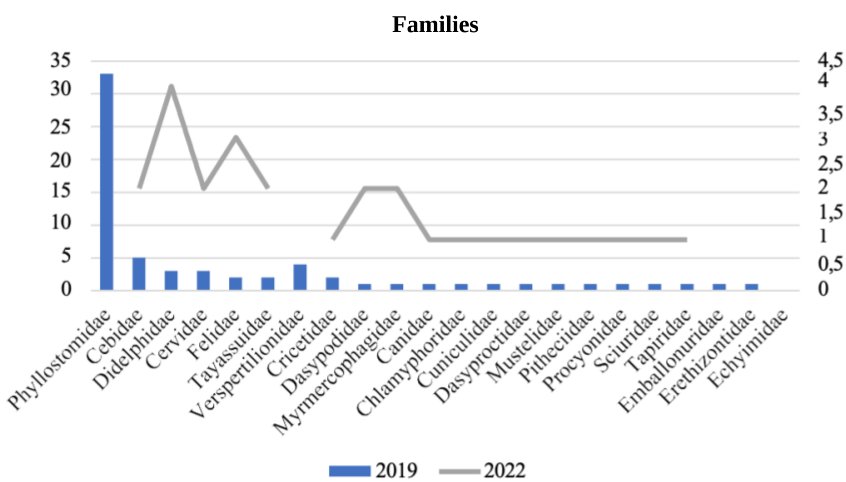
Order	Family	Specie	Vernacular Name	MR	GT	H
Artiodactyla	Cervidae	*Mazama murelia*	Gray Deer	CA	F-Fl	T
		Mazama zamora	Red Deer	CA	F-Fl	T
	Tayassuidae	*Dicotyles tajacu*	Collared Peccary	CA	O	T
		Tayassu pecari	White-lipped Peccary	CA	O	T
Carnivora	Canidae	*Cerdocyon thous*	Fox	A	O	T
	Felidae	*Herpailurus yagouarundi*	Jaguarundi	CA	C	T
		Leopardus pardalis	Ocelot	CA	C	T
		Puma concolor	Puma	CA	C	T
	Mustelidae	*Eira barbara*	Tayra	CA	C	T
	Procyonidae	*Nasua nasua*	Kinkajou	CA	O	T
Cingulata	Chlamyphoridae	*Priodontes maximus*	Giant Armadillo	CA	I	F
	Dasypodidae	*Dasypus novemcinctus*	Nine-banded Armadillo	CA	C	F
		Dasypus kappleri	Long-nosed Armadillo	CA	C	F
Didelphimorphia	Didelphidae	*Didelphis marsupialis*	Common Opossum	CA	O	ES
		Marmosops cf. bishopi	Small Weasel	CA	O	ES
		Metachirus myosurus	Brown Four-eyed Opossum	CA	O	T
		Philander canus	Gray Four-eyed Opossum	CA	O	ES
Perissodactyla	Tapiridae	*Tapirus terrestris*	Tapir	CA	Fl	T
Pilosa	Myrmercophagidae	*Myrmecophaga tridactyla*	Giant Anteater	CA	I	T
		Tamandua tetradactyla	Anteater	CA	I	A
Primates	Cebidae	*Saimiri cassiquiarensis*	Titi Monkey	CA	F-G	A
		Sapajus apella	Tufted Capuchin Monkey	A	F-G	A
	Pitheciidae	*Cheracebus lugens*	Widow Monkey	A	F-G	A
Rodentia	Cricetidae	*Rhipidomys leucodactylus*	Hairy-tailed Rat	A	O	A
	Cuniculidae	*Cuniculus paca*	Paca	CA	G	T
	Dasyproctidae	*Dasyprocta fuliginosa*	Agouti	CA	F	T
	Echyimidae	*Proechimys cf. oconelli*	Spiny Rat	CA	O	T
	Sciuridae	*Hadrosciurus igniventris*	Squirrel	CA	F-G	ES

In faunal surveys conducted in the area, the presence of 72 mammal species was reported (Osorno-Muñoz et al., 2019) using various sampling techniques. Despite this, the present analysis records five species that had not been previously registered. This brings the total to 77 species for the estuary, reflecting 17.5% of the country's diversity (S. Solari et al., 2013). The difference in richness between the two surveys is primarily due to the substantial contribution of species recorded in the order Chiroptera (bats), with 38 species for the area. The following orders exhibit very similar fluctuations: Carnivora, Pilosa, Cingulata, and Didelphimorphia show more species in 2022, while Rodentia, Artiodactyla, and Primates were more prevalent in 2019. As expected, the family Phyllostomidae (leaf-nosed bats) had the highest contribution in 2019, with 33 recorded species. The family dynamics are more variable, as some families not recorded in 2019 are now included in the actual composition of the region through the present analysis (Figure 5).

Figure 5. *Temporal Comparison Between Surveys Conducted in 2019 and 2022 of the Richness Reported at Photodetection Stations at the Mouth of Caño Monos – Matavén Forest A. Orders B. Families*



A.



B.

Using the automatic camera methodology, a capture success rate of 29.98% was achieved. Station 14 had the highest capture rate with 183 captures, while station 2 had the lowest with only two captures (Table 3). The difference between each station can be explained by the differential functioning of the installed equipment and the potential random malfunctions of the automatic camera while exposed to outdoor conditions.

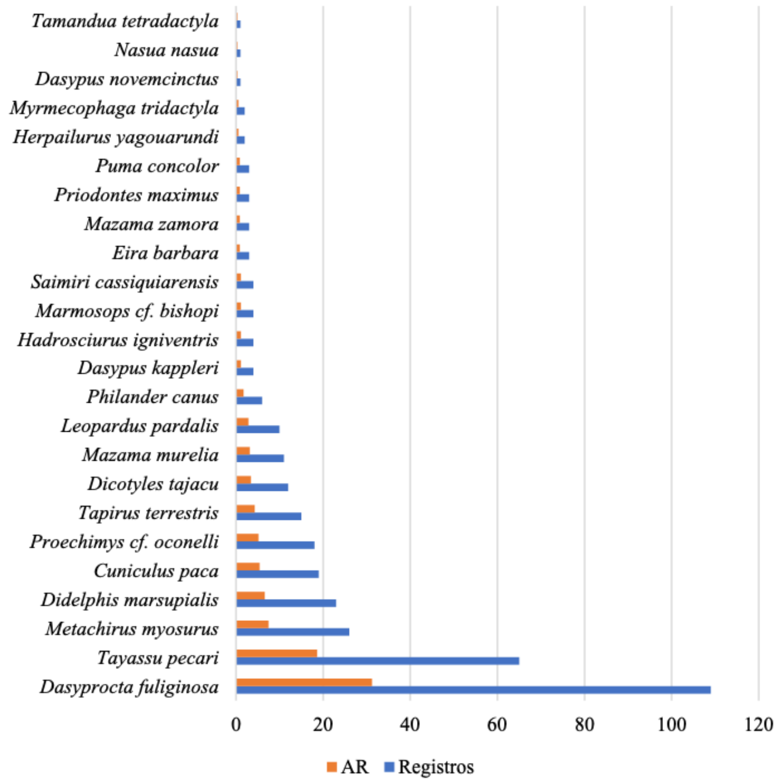
Table 3: *Sampling efforts and capture success at photodetection stations at the Mouth of Caño Monos – Matavén Forest*

Station	Effort (days/camera)	Records	Success Rate (%)
1	70	4	5.71
2	70	2	2.86
3	70	13	18.57
4	70	8	11.43
5	70	24	34.29
6	69	6	8.70
7	69	5	7.25
8	69	14	20.29
9	69	12	17.39
10	68	38	55.88
11	68	35	51.47
12	68	37	54.41
13	68	6	8.82
14	67	123	183.58
15	67	3	4.48
16	66	10	15.15
17	66	9	13.64
TOTAL	**1164**	**349**	**29.98**

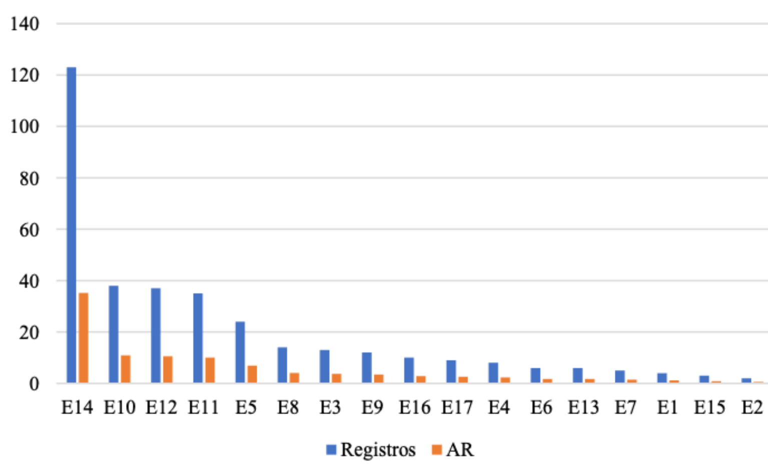
The most abundant species in the sampling was picure (D. punctata) with 109 records and a relative abundance of 31.23%. The second most abundant was cafuche o cajuche (T. pecari) with 65 records and a relative abundance of 18.64%. The third species was the brown four-eyed opossum (M. myosurus) with 26 records and a relative abundance of 7.44%, followed by the common opossum (D. marsupialis) with 23 records and a relative abundance of 6.59% (Figures 6A and 7). The relative abundances reflect good health in potential prey for larger mammals such as pumas and jaguars; however, they may be overestimated due to the limitation of individually identifying some of the recorded species. Species considered rare in the records included the nine-banded armadillo (D. novemcinctus), the coati (N. nasua), and the giant anteater (T. tetradactyla), each with only one record and a relative abundance of 0.28% (Figure 8).

The station with the highest relative abundance was E14 with 123 records and a relative abundance of 35.24%, while the lowest was E2 with two records and a relative abundance of 0.57% (Figure 6B). Station 14 had secondary vegetation in a successional state, where pioneer species are more abundant or use the site as a corridor to areas with greater vegetation cover. In contrast, Station 2 was characterized by a flooded savanna, which, due to the season, showed less mammalian activity and consequently fewer records.

Figure 6. *A. Relative abundances of recorded mammals. B. Relative abundance for photodetection stations at the mouth of Caño Monos – Matavén Forest AR: Relative Abundance*



A.



B.

Figure 7: *Most common mammal species in the photodetection sampling at the mouth of Caño Monos – Matavén Forest*

Picure (*Dasyprocta punctata*)

Cafuche (*Tayassu pecari*)

Brown Four-eyed Opossum (*Metachirus myosurus*)

Common Opossum (*Didelphis marsupialis*)

Figure 8: *Rarest mammal species in the photodetection sampling at the mouth of Caño Monos – Matavén Forest*

Kinkajou (*Nasua nasua*)

Nine-banded Armadillo (*Dasypus novemcinctus*)

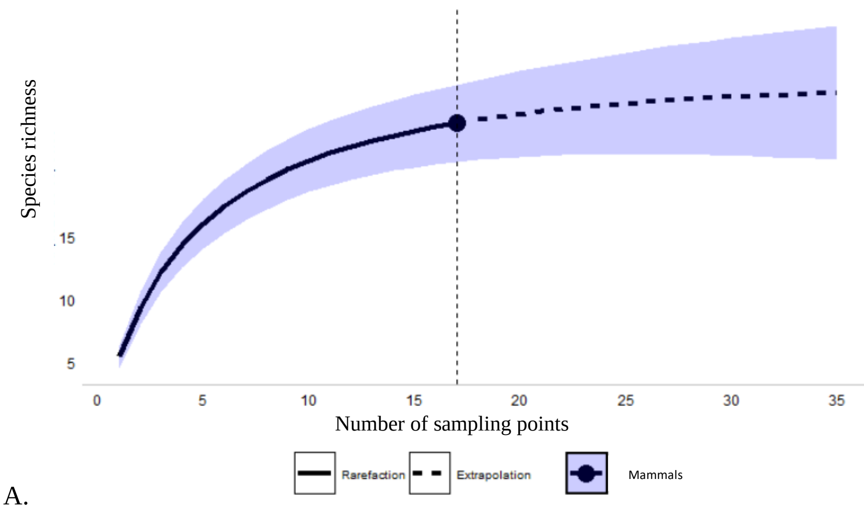
Giant Anteater (*Myrmecophaga tridactyla*)

Jaguarundi (*Herpailurus yagouarundi*)

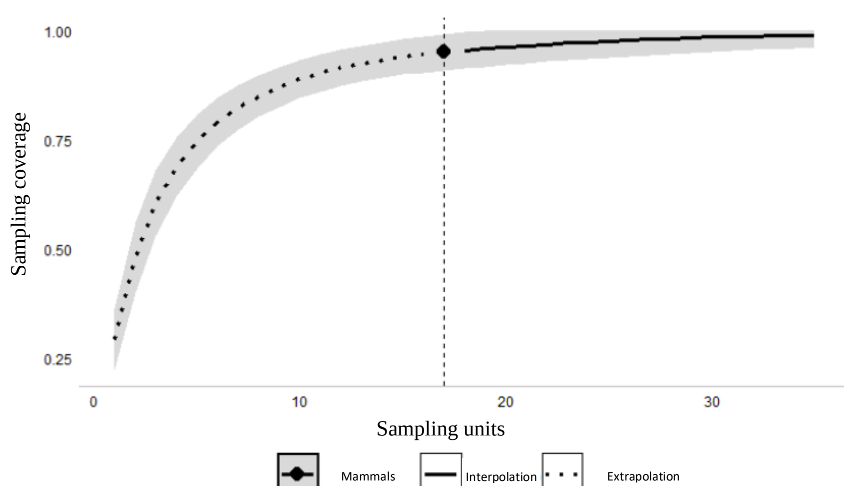
3.2. Representativeness of sampling

In this section, species accumulation curves (rarefaction - extrapolation) suggest that the sampling of the mammalian fauna group encompasses approximately 50% of the estimated species richness. This analysis indicates that at least three times the current sampling effort is required to achieve the remaining 50% of species richness in the area (Figure 9A). Regarding the sampling coverage based on the number of representative units, the 95% threshold was exceeded, indicating that the sample had high coverage in terms of sampling units and, therefore, good representation (Figure 9B). According to these estimators, the species that have yet to be reported are considered rare within the sampling effort, which requires a significant effort to record.

Figure 9*. A. Rarefaction curve based on sample size (solid line) and extrapolation (dashed line, up to twice the sample size) of mammalian species richness. B. Sampling coverage as a function of double the reference size. Confidence intervals at 95% based on a bootstrap with 1000 iterations.*



A.



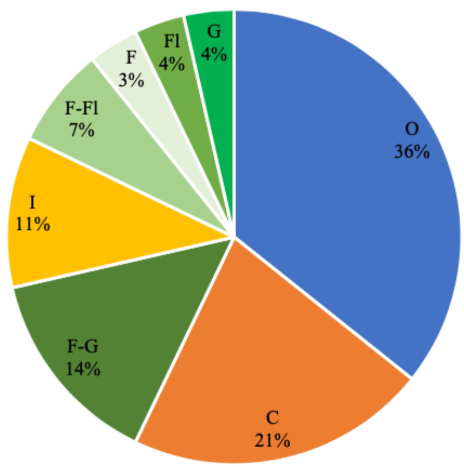
B.

3.3. Trophic guilds

Within the mammalian assemblage recorded during the sampling, omnivorous species were reported in the highest percentage. This group includes members of the order Carnivora, such as foxes, skunks, and raccoons, with marsupials playing a significant role due to the higher tolerance to disturbance exhibited by omnivorous didelphids. Carnivorous mammals, including felines and weasels, constitute 21% of the assemblage. The frugivore-granivore category includes many medium-sized mammals like squirrels, agoutis, and primates, as well as larger species like deer and peccaries. Specialization within the insectivore guild is evident in strictly entomophagous species, such as anteaters. The folivore-frugivore category includes more strictly herbivorous species like rabbits, sloths, larger primates, and some rodents such as pacas. Despite some guilds being represented in a smaller percentage, they include ecologically significant species that are pioneers tolerant to disturbance and contribute to the regeneration of vegetation structures through seed dispersal (Figure 10).

***Figure 10**. Percentage of trophic guilds within the mammalian assemblage recorded during the sampling at the photodetection stations at the mouth of Caño Monos – Selva Matavén*

(N) Nectarivorous, (G) Granivorous, (Fl) Folivorous, (F-Fl) Frugivorous-Folivorous, (F-G) Frugivorous-Granivorous, (F) Frugivorous, (C) Carnivorous, (O) Omnivorous, (I) Insectivorous.



The broad diversity in morphology and ecological adaptations within the class Mammalia has resulted in different functional groups that play critical roles in regulating trophic chains and consequently in plant regeneration. Bats and field rodents, active during the night, along with small primates and medium-sized rodents (squirrels) during the day, consume and disperse a wide variety of small seeds between isolated areas, promoting the regeneration of different plant species and enabling eventual pollination between isolated patches (Carthew & Goldingay, 1997; Forget & Milleron, 1991). Populations of small to medium-sized insectivorous-omnivorous mammals, such as armadillos and certain species of bats and marsupials, control insect and invertebrate populations, which reduces the negative impact of some species on plants. Additionally, by controlling mosquito populations, they positively influence the reduction of the transmission of many tropical diseases (Morrison & Lindell, 2012). Large rodents like agoutis and pacas disperse larger seeds that are unavailable to the first group. By passing these seeds through their digestive tracts or through their habit of transporting and burying them, they increase the germination rate of larger plant species (Galetti et al., 2010). The presence of mesocarnivores, such as mustelids and canids, regulates populations of small rodents and stabilizes trophic chains. Carnivores with mixed prey diets, such as the ocelot, control a broad spectrum of herbivores, which helps increase plant diversity (Roemer et al., 2009). Large herbivorous mammals, such as peccaries and deer, prevent the clustered distribution of plant species, thereby increasing floristic diversity (Augustine & McNaughton, 1998).

3.4. Diversity analysis

Alpha Diversity

The Shannon-Weaver index (H) expresses the evenness of importance values across all species in the sample. H typically ranges between 1 and 4.5, with values below 2 indicating low diversity. For the evaluated sites, the diversity is low, with modest species richness. The highest values were observed in Savanna and Secondary Forest cover and regenerating vegetation, with species richness represented by 11 and 3 species, respectively. The Simpson index (D) indicates dominance; values closer to 1 signify higher dominance. In this case, no sector showed high dominance, but sites with lower richness and moderate abundance exhibited high values in this index. This was evident in the primary floodplain forest and secondary forest, with species representations of 21 and 16 species, respectively (Table 4).

Table 4*. Richness estimators for the mammal community recorded during sampling at the photodetection stations at the mouth of Caño Monos – Selva Matavén*

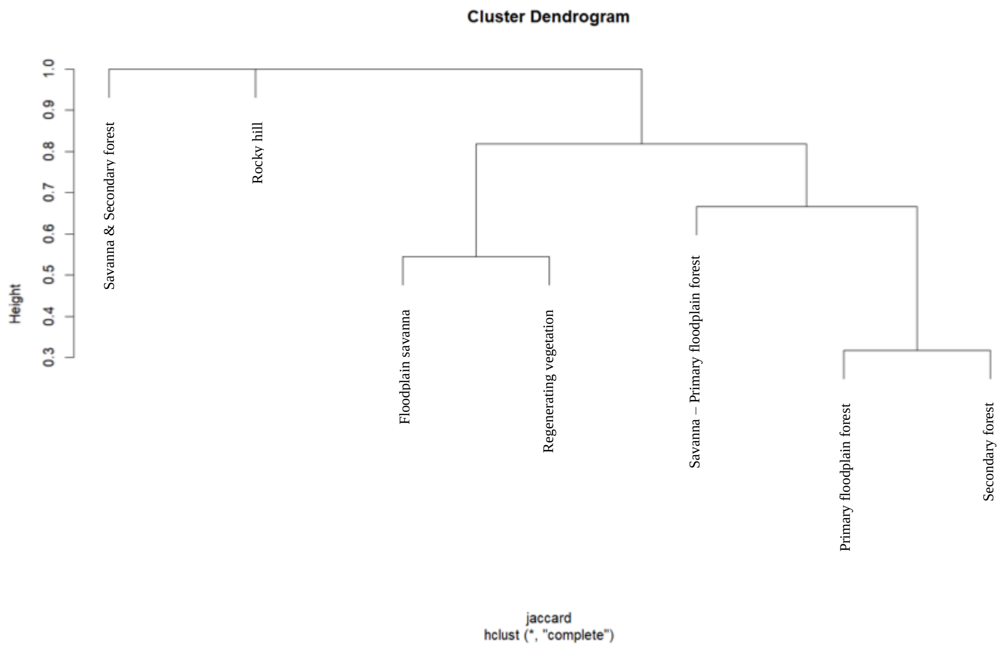
BPI: Primary Floodplain Forest BS: Secondary Forest CR: Rocky Hill SI: Floodplain Savanna SBS: Savanna and Secondary Forest SBPI: Savanna-Primary Floodplain Forest VS: Regenerating Vegetation

Diversity index	BPI	BS	CR	SI	SBS	SBPI	VR
Richness	21	16	1	5	3	7	11
Abundance	130	55	3	9	5	14	133
Shannon-Weaver	0.1318	0.122	1	0.2593	0.44	0.1837	0.3805
Dominance_D	0.8682	0.878	0	0.7407	0.56	0.8163	0.6195

Beta Diversity

The index consistently shows four branches of similarity. The first group comprises the savanna and secondary forest. The second group includes the rocky hill, the third group consists of the floodplain savanna and regenerating vegetation, and the fourth group comprises the savanna and primary floodplain forest, the primary floodplain forest, and the secondary forest. The points in the third group share 48% of the species (Ij=0.74). For the fourth group, approximately 79% of the species are shared (Ij=0.34) (Figure 11).

Figure 11*. Dendrogram of the Jaccard Coefficient (Ij) in the composition of mammalian species among the evaluated sites during the sampling at the photodetection stations at the mouth of Caño Monos – Selva Matavén*



3.5. Species of special interest, their use, and cultural valuation

The most threatened species found in the sampling is the lowland tapir (*Tapirus terrestris*), which is globally categorized as Vulnerable (VU) but is Critically Endangered (CR) in Colombia and listed in Appendix II of CITES. The giant anteater (*Myrmecophaga tridactyla*) is classified as Vulnerable (VU) both globally and nationally and is also listed in Appendix II of CITES. Similarly, the giant armadillo (*Priodontes maximus*) is globally listed as Vulnerable (VU) and as Endangered (EN) nationally, with a CITES Appendix I listing. The white-lipped peccary (*Tayassu pecari*) is globally categorized as Vulnerable (VU), but in Colombia, it is of Least Concern, while it is listed in Appendix II of CITES. The spiny rat has a global classification of Data Deficient (DD) and is an endemic species with no threat category in Colombia.

Globally, the ocelot (*Leopardus pardalis*) and the puma (*Puma concolor*) are categorized as Least Concern (LC); however, in Colombia, these species are Near Threatened (NT) and listed in Appendix I of CITES. Additionally, the jaguarundi (*Herpailurus yagouaroundi*), collared peccary (*Dicotyles tajacu*), crab-eating fox (*Cerdocyon thous*), tufted capuchin (*Sapajus apella*), and the widow bird (*Cissopis leverianus*) are listed in Appendix II of CITES without any special threat category.

Puma - *Puma concolor* (Linnaeus, 1771)

Threat Status

IUCN: LC (Least Concern)
Red Book of Colombian Mammals: NT (Near Threatened)
Resolution 1912 of 2017: NC (Not Classified)
CITES: Appendix I

Diet: Carnivorous. Capable of hunting large prey when available; however, the most important components of its diet are small to medium-sized animals.

Description: Total Length (TL): 860-1540 mm Head-Body Length (HB): 630-960 mm Tail Length (TL): 230-290 mm Hind Foot Length (HFL): 83-102 mm Weight: 29-120 Kg. The fur is generally golden but can range from silvery gray to reddish. The ventral region is paler than the dorsal side. The face is pale with whitish spots around the muzzle and throat. A dark spot is present at the base of the whiskers. The tail is long, J-shaped, and has a blackish tip. No body spots are present except in newborns, which have brown spots that disappear by 12 months of age (Cuartas-Calle & Marín-C, 2014).

Distribution and Habitat: The distribution range extends from Canada, through the United States, to Chile. In Colombia, it is found in all geographic regions from 0 to 4100 meters above sea level. It is solitary, discreet, and crepuscular. The gestation period is 91 days, with a litter size of two or three cubs (Cuartas-Calle & Marín-C, 2014).

Anthropogenic Pressure: It is pursued and hunted when feeding on livestock. Roads also pose significant danger and are the greatest barrier to local dispersal movements (Nielsen et al., 2023).

Ocelot - *Leopardus pardalis (Linneus, 1758)*

Threat Status

IUCN: LC (Least Concern)
Red Book of Colombian Mammals: NT (Near Threatened)
Resolution 1912 of 2017: NC (Not Classified)
CITES: Appendix I

Diet: Carnivorous. Its diet includes mammals, birds, and reptiles, but also fruits and insects.

Description: Total Length (TL): 700-900 mm Head-Body Length (HB): 320-410 mm Tail Length (TL): 140-170 mm Hind Foot Length (HFL): 50-65 mm Weight: 11-14.5 kg. The dorsal coloration ranges from yellow to reddish-gray. Ventrally, they are white. They have dark stripes or rosettes arranged in small groups of dark areas that form parallel horizontal chains. There are two black lines on their cheeks and one or two transverse stripes on their limbs. The forelimbs have five toes, and the hind limbs have four; the claws are equipped with pads and retractable nails. In relation to body size, the limbs are broad and large (Cuartas-Calle & Marín-C, 2014).

Distribution and Habitat: The species ranges from Mexico to Brazil and Uruguay. In Colombia, it is found in all geographic regions from 0 to 2400 meters above sea level. This species occupies a wide range of habitats, including mangroves, coastal swamps, grasslands, scrublands, and all types of tropical forests (primary, secondary, evergreen, seasonal, and montane). It is crepuscular but can be active during the day. They are solitary except during the mating season when males have territories overlapping with many female territories. After a gestation period of 72 to 82 days, females give birth to one or two offspring. It is vulnerable to hunting and habitat loss (Cuartas-Calle & Marín-C, 2014).

Anthropogenic Pressure: Deforestation of its habitat, livestock farming, mining, illegal logging, and urban expansion. Additionally, illegal capture for the pet trade (IUCN, 2023).

Ocarro - *Priodontes maximus* (Kerr, 1792)

Threat Status

IUCN: VU (Vulnerable)
Red Book of Colombian Mammals: EN (Endangered)
Resolution 1912 of 2017: EN (Endangered)
CITES: Appendix I

Diet: Feeds on insects, considered the most specialized armadillo with a diet of ants and termites, which it obtains by digging up their nests (Tirira, 2007).

Description: Total Length (TL): 832-1000 mm Head-Body Length (HB): 500-550 mm Tail Length (TL): 180-200 mm Hind Foot Length (HFL): 45-60 mm Weight: 18.7-32.3 kg**.** It is the largest living species of armadillo. The back is covered by a bony armor with 11 to 13 central movable bands; the armor appears too small for the body size, not covering the flanks. The coloration of the shell is dark brownish-gray with light yellow and cream edges, often covered with clay (Tirira, 2007).

Distribution and Habitat: It inhabits the eastern Andes of Colombia, Ecuador, Peru, and northwest Venezuela, the French Guiana, Suriname, Guyana, Brazil, Bolivia, Paraguay, and northern Argentina (Wetzel et al., 2007; Carter et al., 2015).

Anthropogenic Pressure: Deforestation of its habitat, livestock farming, mining, illegal logging, and urban expansion (IUCN, 2023).

4. RECOMMENDATIONS FOR CONSERVATION

In the area, a wide taxonomic diversity of species was recorded, representing 59.62% of the mammals reported for the region. Some of these species, such as certain marsupials (*Didelphis marsupialis and Metachirus myosurus*), exhibit a high tolerance to environmental disturbance and can even be found in urbanized environments (Barquez et al., 2015; Pérez-Hernández, 2016; Sampaio et al., 2016; Solari, 2019; Astúa et al., 2021). However, most of the recorded mammals show low to moderate tolerance to disturbance, with habitat loss and fragmentation being the primary threats to their conservation (IUCN, 2023). This implies that to conserve these species, connectivity and ecological restoration strategies that provide high-quality habitats must be implemented first.

Among the species with low tolerance to habitat disturbance are primates like the widow monkey (*Cheracebus lugens*) and the tufted capuchin (*Sapajus apella*). For these species, deforestation and habitat transformation have been identified as major threats to their conservation (Link et al., 2007; Link et al., 2021). On the other hand, a significant percentage of the recorded species show medium tolerance to environmental disturbance. These species include carnivores such as the ocelot (*Leopardus pardalis*) and nectarivorous bats like Hsunycteris thomasi, as well as anteaters (*Tamandua mexicana*) and the lowland tapir (*Tapirus terrestris*), among others (IUCN, 2023).

Another threat faced by some species, primarily carnivores, is retaliatory hunting due to conflicts with domestic animals like chickens. Poor management of these domestic animals, allowing them to roam freely without supervision and the lack of enclosures to keep them safe at night, leads to the predation of poultry by local carnivores. This generates a conflict in which the animals are eventually hunted to stop the predation of poultry. Species threatened by retaliatory hunting include the ocelot (*Leopardus pardalis*), the tayra (*Eira barbara*), and the common opossum (*Didelphis marsupialis*) (Paviolo et al., 2015; Cuarón, 2016; Astúa et al., 2021).

Additionally, the consumption of wild animals poses a threat both to the species being hunted and to the predators that feed on these mammals. Species such as the paca (*Cuniculus paca*), the nine-banded armadillo (*Dasypus novemcinctus*), collared peccaries (*Dicotyles tajacu*), and white-lipped peccaries (*Tayassu pecari*) are commonly hunted by local communities for their meat. However, these species are part of the diet of medium-sized predators like the ocelot (*Leopardus pardalis*) and the tayra (*Eira barbara*) (Paviolo et al., 2015; Cuarón, 2016). This can cause an ecological imbalance, where in the absence of larger prey, these predators might start preying on smaller species, leading to competition with smaller predators with which they previously did not compete. Alternatively, these predators might resort to domestic animals as a food source.

Furthermore, hunting with dogs typically involves the movement of dogs within forest areas, leading to dogs consuming other species such as rodents, thereby competing with other predators (Zapata-Ríos & Branch, 2016). Additionally, dogs are vectors of various diseases such as distemper and rabies, which can be transmitted to wildlife, posing a significant threat to them.

Based on the above, three main recommendations are made for the conservation of mammalian species:

1. Protect already monitored areas and seek new areas to connect through active and passive restoration strategies.

2. Provide training to the local community on the proper management of domestic animals, primarily poultry and dogs.
3. Avoid hunting wildlife for consumption and the free roaming of dogs within forest areas.

5. CONCLUSIONS

The richness and abundance estimators consistently showed that the sampling effort has been sufficient to report and establish some biotic dynamics within the mammal group during this sampling period. This is particularly true at a landscape scale, where mammalian methodologies are more efficient, maximizing records through continued effort over time. However, for each evaluated unit, the estimators suggest that a representative percentage of mammalian diversity remains unrecorded. This result is consistent with the argument that the recording effort for each site is small compared to the entire sampling effort. Despite this, the current analysis enhances the knowledge of regional diversity by using appropriate methodologies for mammal recording.

The size of open areas and landscape structure can influence local abundances of mammals, and this aspect should be considered in research (Avila-Cabadilla et al., 2009). The data found in this study suggest that the dominance of intervened areas can cause a significant reduction in the diversity of this important faunal group. Therefore, creating connectivity between the different evaluated areas is crucial. This will help preserve the diversity of bat species in the region, as well as their important ecological roles (pollination, seed dispersal, and invertebrate control). It is evident that conditions for mammalian fauna in areas with reduced diversity and vegetation density are much inferior compared to larger sites. This is mainly due to the characteristics of vegetation structure, as the latter coverage exhibits several microhabitat features with available resources such as food and shelter, which affect the birth and mortality rates of the recorded species (Sánchez-Hernández et al., 2001), maintaining viable populations.

In general, it has been demonstrated that certain environmental characteristics, such as floristic composition, precipitation, and temperature range, influence the number and diversity of animal species that can be recorded in a particular area. Accordingly, despite the limitations and inconveniences of the methods used, the richness found in the monitoring suggests that the composition and structure of the vegetation, along with the biota in this coverage, are providing the necessary resources for sustaining mammal populations.

For the altitude and ecoregion, many mammal species remain unrecorded, which is due to the high levels of intervention in many of the evaluated areas, such as selective deforestation. This will act on two fronts: providing resources for the colonization of different species, which, through ecological restoration processes, will aid in vegetation regeneration. Despite this, the results of the present analysis show that the vegetated areas in the Caño Mataven basin are fundamental in establishing and maintaining the mammal community, as they provide the necessary microhabitats to guarantee various crucial resources that are differentially utilized by these organisms.

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