PNAS
www.pnas.org

Supplementary Information for

Human-modified landscapes alter mammal resource and habitat use, and trophic structure

Marcelo Magioli, Marcelo Zacharias Moreira, Renata Cristina Fonseca, Milton Cesar Ribeiro, Márcia Gonçalves Rodrigues, Katia Maria Paschoaletto Micchi de Barros Ferraz

Marcelo Magioli
Email: marcelo.magioli@gmail.com

This PDF file includes:

www.pnas.org/cgi/doi/10.1073/pnas.1904384116

Supporting Results

Data robustness test. To test the robustness of our results, we reanalyzed our data (N = 29 species; Table S1) using only values from species found in both preserved areas and HMLs (N = 16 species). The purpose of this reanalysis was to demonstrate that the results obtained by the comparison of trophic guilds were not influenced by interspecific differences in resource use. We observed that the patterns obtained by reanalysis were consistent with our original results when comparing trophic guilds across habitat types within each system (Figs. 2A-D; Figs. S1A-D). The patterns presented by the comparison of guilds between systems were also very similar (Figs. 2C, 2F; Figs. S1C, S1F), with differences only for omnivores [$\delta^{13}C$: $F_{(1,10)} = 3.3$, $p = 0.0993$; $\delta^{15}N$: $F_{(1,10)} = 0.69$, $p = 0.4255$] and insectivores [$\delta^{13}C$: $F_{(1,18)} = 7.62$, $p = 0.0128$], but the differences in $\delta^{13}C$ values and trophic structure ($\delta^{15}N$ values) were maintained.

Supporting Materials and Methods

Study areas. The study sites are within the Atlantic Forest domain, a tropical and subtropical biome classified as a continuum of tree species distributions (1, 2), with rainfall distribution delimiting the different forest formations (2). The main vegetation types at our study sites are evergreen forests in preserved areas and semideciduous forests in human-modified landscapes (HMLs). According to the literature, both vegetation types are very similar in terms of $\delta^{13}C$ and $\delta^{15}N$ values (3, 4). Our study HMLs are mainly composed of C_4 monodominant crops (e.g., sugarcane) and pastures, and the forest remnants are immersed in this type of agricultural matrix, which extends across most of the Atlantic Forest (5). Based on the distribution of C_3 and C_4 plants, forest remnants in preserved areas are expected to be sources of C_3-carbon, while HMLs may provide C_4-carbon due to the dominance of C_4 crops and pastures (6, 7). Thus, based on the landscape composition of the study systems, we expect forest remnants to provide C_3 resources, while the agricultural matrix may provide mainly C_4 resources. Photographs characterizing the preserved areas, HMLs, interior forest remnants, forest floor, and sugarcane crops are shown in Fig. S5. The preserved areas present the most complete mammal assemblages, including sensitive species, and are the least affected by anthropogenic activities of all areas within the Atlantic Forest (8). Landscapes with high forest cover are scarce in the Atlantic Forest, and large remnants (> 5000 ha) represent only ~0.03% of the total remaining forest fragments (9). Conversely, HMLs are the most common landscape type in the biome and are generally composed of small and isolated forest remnants immersed in agricultural and pasture matrices (10), and the mammal assemblages are less diverse than those in the preserved areas (11).

Collection of fecal samples and hair in preserved areas. Between October 2014 and July 2016, we conducted 16 sampling campaigns lasting five days each, with four campaigns at each sampling site. We collected fecal samples from dirt roads and trails at each sampling site (Fig. S6). The total sampling effort was 850 km traversed in 80 field days, resulting in the collection of feces from 156 carnivores. The samples were placed in plastic bags labeled with the site of collection, date and trail and then stored in a refrigerator at the Wildlife Ecology, Management and Conservation lab (LEMaC), Forest Sciences Department, University of São Paulo

(ESALQ/USP). Hair sample collection occurred concomitantly with feces collection in the same sampling areas. We installed five hair traps made of barbed wire at each sampling site distributed at varying distances along and beside trails and dirt roads, resulting in the collection of 41 hair samples from 11 species (*Mazama* sp., *Pecari tajacu*, *Tayassu pecari*, *Leopardus guttulus*, *Puma concolor*, *Didelphis aurita*, *Tapirus terrestris*, *Myrmecophaga tridactyla*, *Sapajus nigritus*, *Cuniculus paca*, and *Dasyprocta* cf. *azarae*). For details on trap locations and a discussion of results, see Magioli et al. (12). Sample collection was authorized by SISBIO permit n. 43680-3, and access to protected areas was granted through COTEC permit n. 260108 – 003.547/2014.

Fecal sample screening and hair identification. For fecal screening, we adapted the method proposed by Korschgen (13), which consists of fragmenting and soaking the samples in water with detergent and alcohol for at least one day and then subsequently washing them in running water with a 1 × 1 mm mesh sieve. The resulting material was dried in an oven at 50 °C and then screened by removing the food items (e.g., hair, bones, claws, feathers, teeth, plant material, seeds), which were placed in plastic bags for the identification of prey and predator guard hairs. We identified the samples using hair microstructure (i.e., cuticle imprints and medullar analysis), adapting the method proposed by Quadros (14). First, we cleaned the guard hair with 70% alcohol and dried it with absorbent paper. Then, we placed the hair on a slide coated with a thin layer of partially dried transparent nail polish and covered it with another slide. The set of slides was then pressed in a manual vise and left to rest for ~30 min. Finally, the hair was carefully removed from the slide, and its imprint was observed and photographed under a microscope at 400× magnification. For medullar analysis, we placed the guard hair on a slide holding a drop of water and covered it with a glass cover. Then, we observed and photographed the medullar pattern under a microscope at 400× magnification. To identify the hair cuticle imprints and medullar patterns, we compared our records with photos from Quadros (14), Miranda et al. (15), Amaro (16) and Magioli et al. (11) and slides from reference collections of museum specimens. We conducted all laboratory procedures at LEMaC – ESALQ/USP.

Samples for stable isotope analysis (SIA). We used mammal hair for the SIA because hairs are metabolically inert tissues, retaining information over a large temporal window of a few months (17). For the analysis of stable carbon and nitrogen isotopes, we first cleaned the hairs with water and 70% alcohol to remove residues; then, the samples were dried with absorbent paper and chopped and finally stored in tin capsules. Finally, we submit samples for SIA.

Calculation of the C_3 and C_4 carbon content. We calculated the C_3 and C_4 carbon content in each sample ($\delta^{13}C$ values corrected by $\Delta^{13}C$ values) using the following equation:

$$C_3\text{-derived carbon (\%)} = \frac{\delta^{13}C_{\text{corrected sample}} - \delta^{13}C_{\text{mean } C_4 \text{ vegetation}}}{\delta^{13}C_{\text{mean } C_3 \text{ vegetation}} - \delta^{13}C_{\text{mean } C_4 \text{ vegetation}}} * 100$$

We used the mean $\delta^{13}C$ value of -32‰ as the base for our model to indicate resources originating in the forest remnants (C_3 plants) and -12‰ V-PDB in the agricultural matrix (C_4 plants). These values were obtained from the extreme $\delta^{13}C_{corrected}$ values of all mammal samples analyzed and baseline items collected and analyzed in the same studied areas (18, 19).

Estimation of fractionation factors. To estimate fractionation factors ($\Delta^{13}C$ and $\Delta^{15}N$), we used the 'SIDER' package (20) available in R 3.4.3 (21), which estimates species-specific fractionation factors from phylogenetic regression models according to a database of fractionation values available for several species. Although fractionation factors are more accurate when obtained experimentally, 'SIDER' generates reliable values for most species without existing

values (20), being better than generalizations for entire trophic guilds. This package permits the selection of diet type for the analysis, with 'herbivores', 'omnivores' and 'carnivores' as options; therefore, we used 'herbivores' for species we classified as herbivores and frugivores and 'carnivores' for both insectivores and carnivores. We generated fractionation factors using the script available in Healy et al. (20) (Table S6).

Isotopic niche analysis. To assess the difference in resource use between trophic guilds, we analyzed the size of the isotopic niches using the 'SIBER' package (22) in R 3.4.3. This package calculates the standard ellipse area (SEA) using the $\delta^{13}C_{corrected}$ and $\delta^{15}N_{corrected}$ values, which contain 40% of the data independent of the sampling size, allowing the comparison of the isotopic niche width between the guilds in the different systems. This method accounts for the central area of the isotopic niches, which is less sensitive to sample size, allowing highly robust comparisons between guilds and systems. To account for the sample size, we used the SEA corrected (SEAc). To compare the isotopic niches between guilds, we calculated the Bayesian estimate of the SEA (SEAb). The ellipses were calculated and compared between guilds in the different systems, and their overlap was evaluated

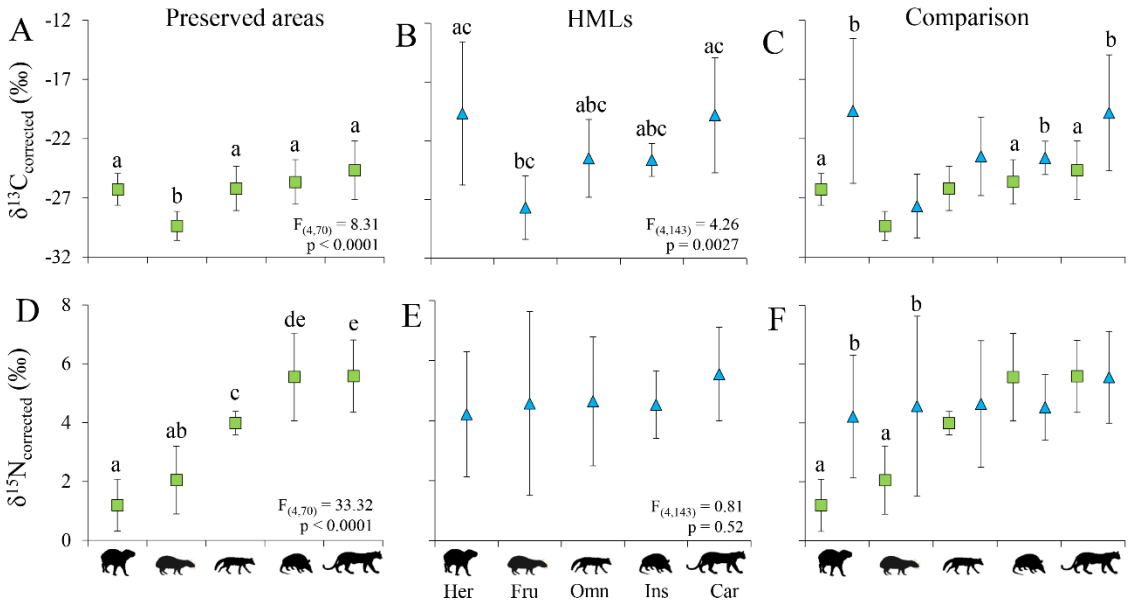

Fig. S1. Reanalysis of the comparison of $\delta^{13}C$ and $\delta^{15}N$ values among mammal trophic guilds in the Atlantic Forest, state of São Paulo, Brazil. Mean $\delta^{13}C_{corrected}$ and $\delta^{15}N_{corrected}$ values ± standard deviation for mammal trophic guilds in preserved areas (A, D), human-modified landscapes (HMLs) (B, E), and both systems together (C, F). Lowercase letters indicate relationships with significant differences ($p < 0.01$, $p < 0.05$). (Her = herbivores; Fru = frugivores; Omn = omnivores; Ins = insectivores; Car = carnivores).

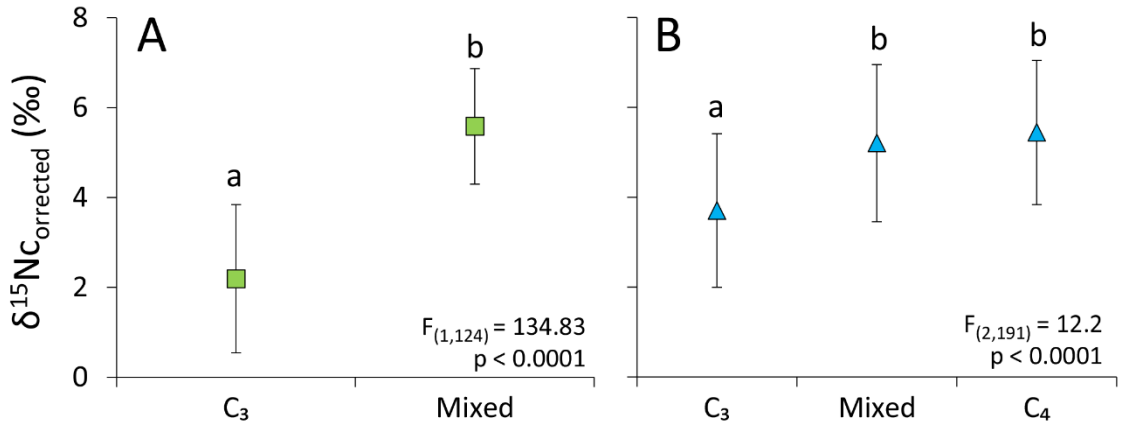

Fig. S2. Stable nitrogen isotopes values used to compare resource use of mammals of the Atlantic Forest, state of São Paulo, Brazil. Comparison of mean $\delta^{15}N$ values ± standard deviation for C_3, mixed and C_4 groups (in terms of C_3- and C_4-derived carbon) of mammal species in preserved areas (A) and human-modified landscapes (HMLs) (B). Lowercase letters indicate relationships with significant differences ($p < 0.01$, $p < 0.05$).

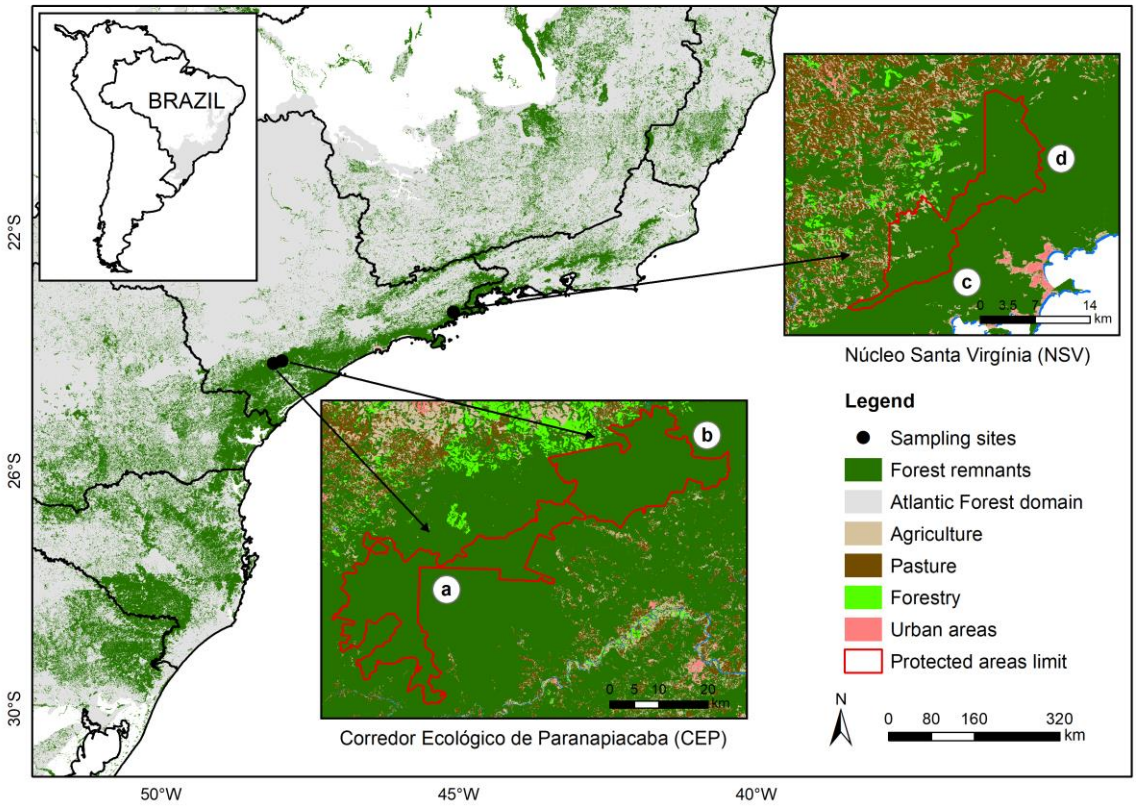

Fig. S3. Sampling sites in preserved areas of the Atlantic Forest, state of São Paulo, Brazil. Corredor Ecológico de Paranapiacaba: Intervales State Park (a) and Carlos Botelho State Park (b); Two research bases of Núcleo Santa Virgínia, an administrative division of the Serra do Mar State Park: Vargem Grande (c) and Itamabuca (d). The description of the sampling sites is shown in Table S4.

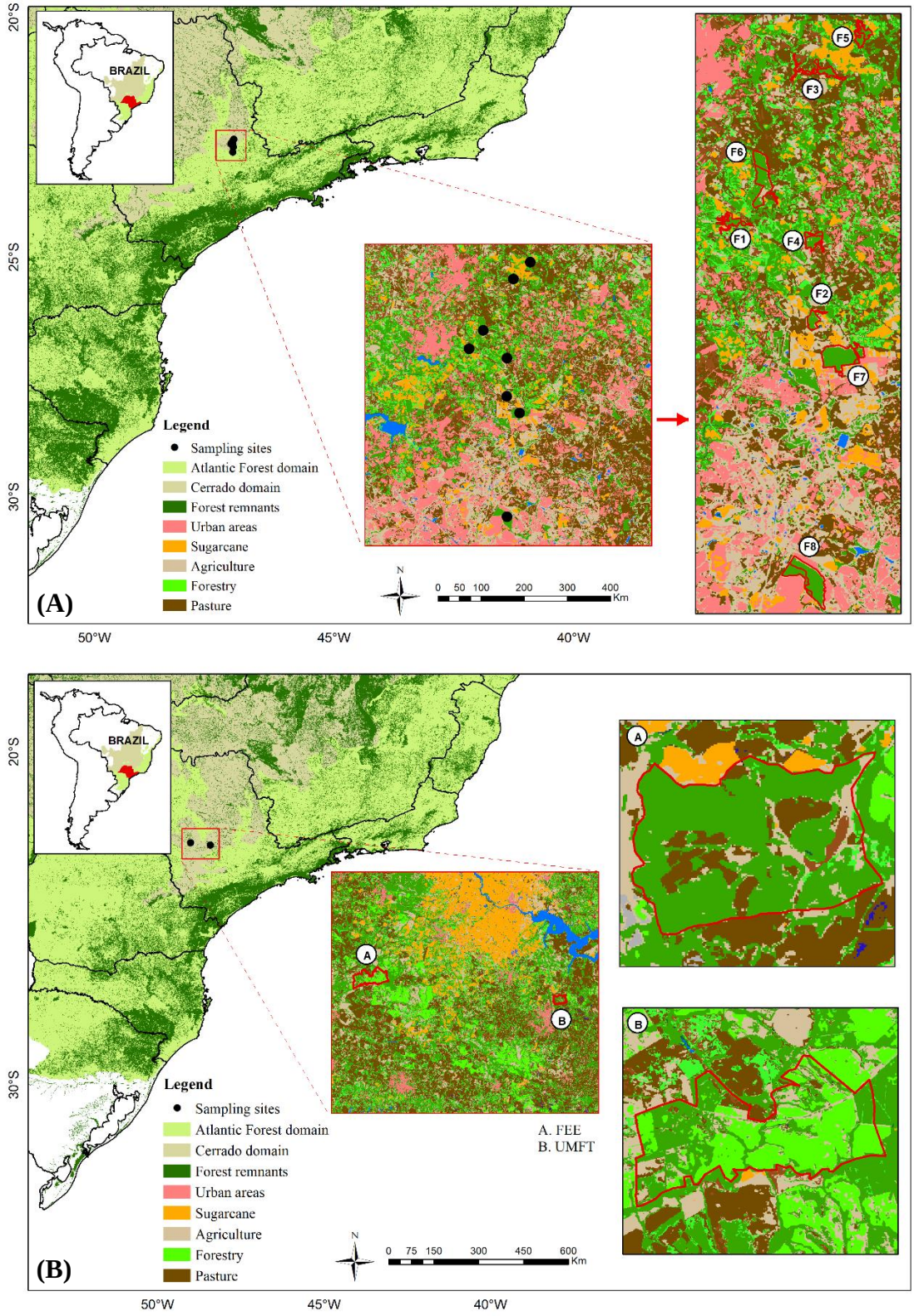

Fig. S4. Sampling sites in human-modified landscape (HMLs) of the Atlantic Forest, state of São Paulo, Brazil. (A) The central portion of the metropolitan region of Campinas; (B) A portion of Botucatu region. The description of the sampling sites is shown in Table S5.

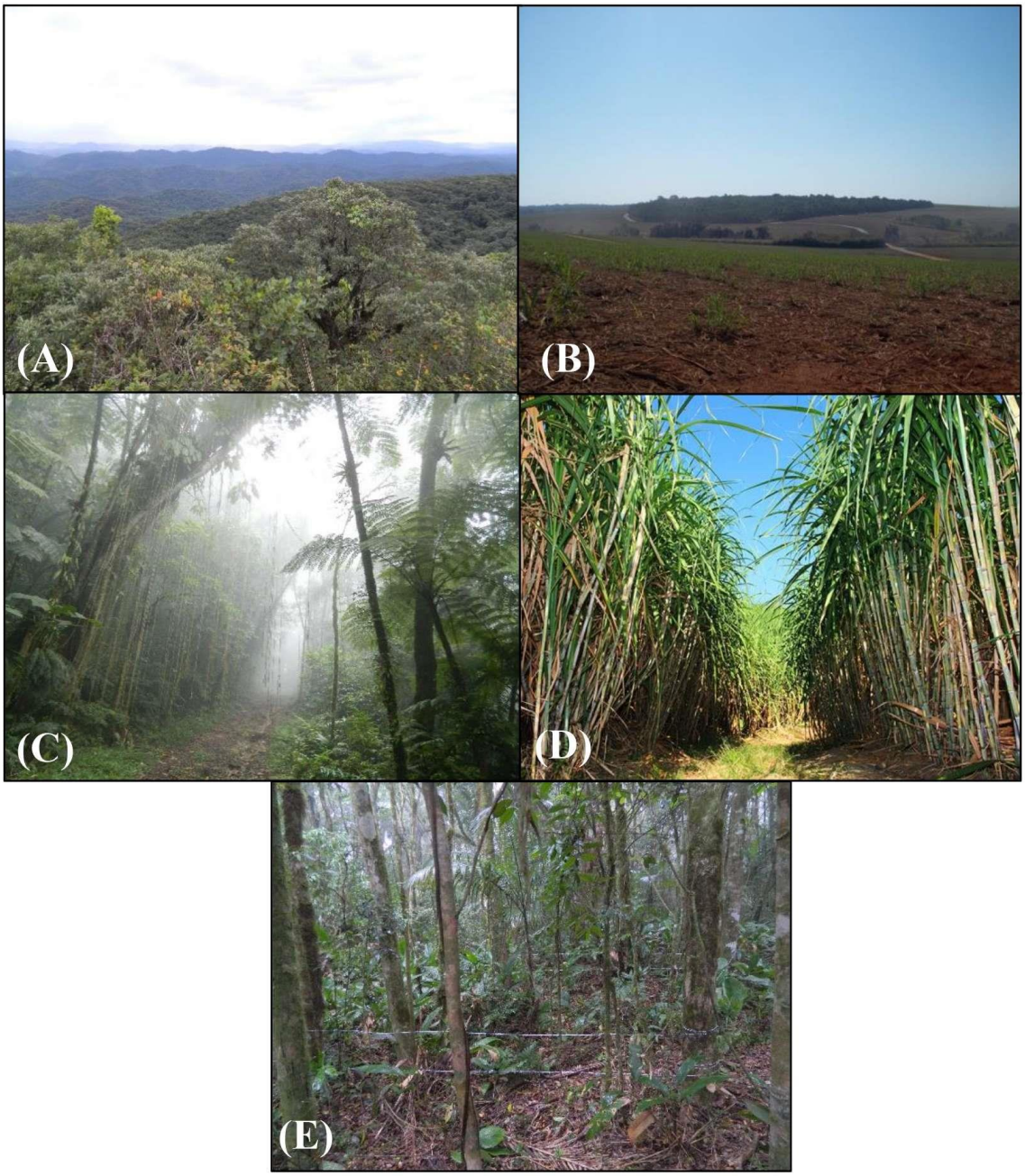

Fig. S5. Photographs characterizing some aspects of the two study systems in the Atlantic Forest, state of São Paulo, Brazil. (A) A view of the large remnant of continuous forest of the Atlantic Forest biome (Intervales State Park, Fig. S3, Table S4). (B) A view of a human-modified landscape (HMLs) composed of forest remnants immersed in sugarcane crops (ARIE Matão de Cosmópolis, Fig. S4A, Table S5). (C) A trail inside of a forest remnant (Núcleo Santa Virgínia, Fig. S3, Table S4). (D) A path inside of a sugarcane crop [Mata da Meia Lua (F7), Fig. S4A, Table S5]. (E) View of the forest floor of a forest remnant in the Atlantic Forest (Carlos Botelho State Park, Fig. S3, Table S4).

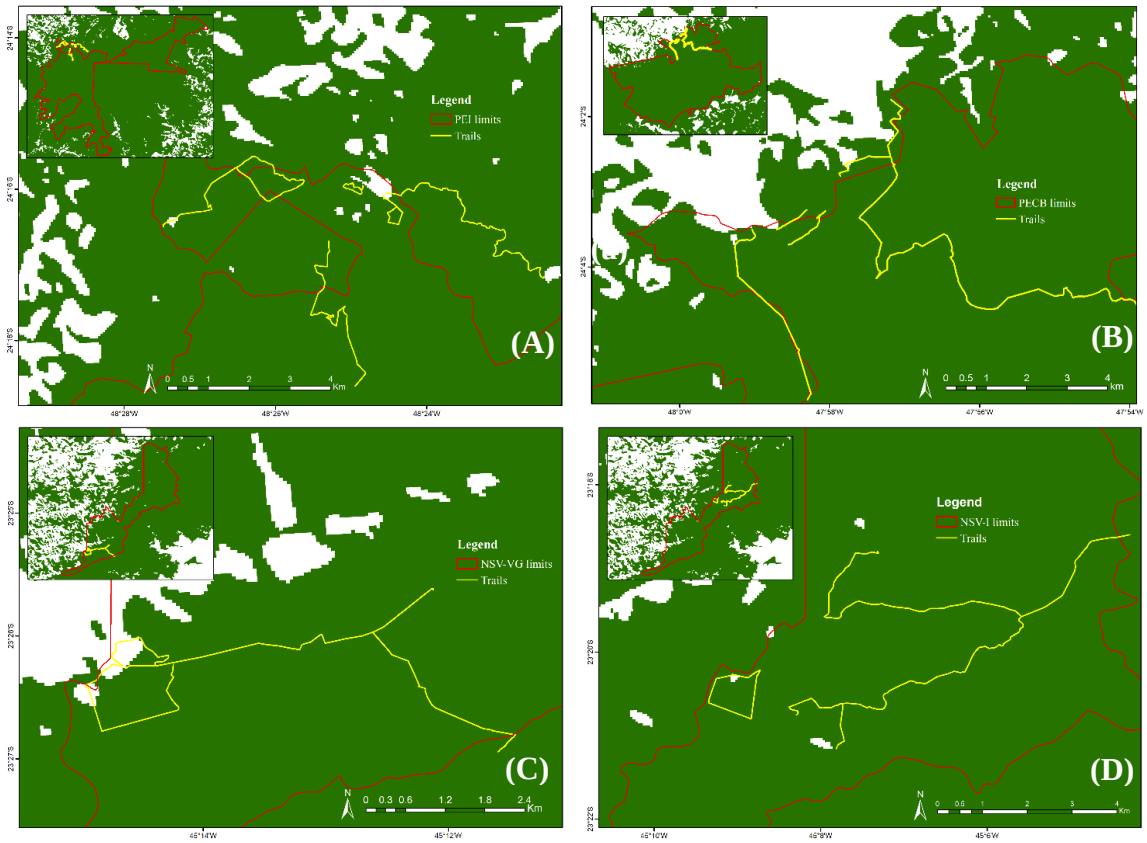

Fig. S6. Location of the trails and dirt roads traversed for the collection of fecal samples in preserved areas of the Atlantic Forest, state of São Paulo, Brazil. (A) Intervales State Park; (b) Carlos Botelho State Park; (c) and (d) two research bases of the Núcleo Santa Virgínia, an administrative division of the Serra do Mar State Park (Vargem Grande and Itambuca, respectively).

Table S1. Stable carbon and nitrogen isotopes values for mammals of the Atlantic Forest, state of São Paulo, Brazil. Corrected and uncorrected mean $\delta^{13}C$ and $\delta^{15}N$ values ± standard deviation (SD) for all mammal species analyzed in preserved areas and human-modified landscapes (HMLs), incluing the number of samples per species, and the total number of samples for each system.

Taxon	N	Uncorrected (‰)				Corrected (‰)			
		$\delta^{13}C$	**SD**	**$\delta^{15}N$**	**SD**	**$\delta^{13}C$**	**SD**	**$\delta^{15}N$**	**SD**
Preserved areas	**126**								
Cabassous tatouay	2	-22.3	2.1	10.4	2.2	-24.4	2.1	7.1	2.2
Coendou spinosus	7	-24.0	0.5	4.8	0.7	-26.8	0.5	1.3	0.7
Cuniculus paca	7	-25.7	1.1	5.8	0.9	-28.5	1.1	2.4	0.9
Dasyprocta azarae	1	-28.1	0.0	7.2	0.0	-31.0	0.0	3.8	0.0
Dasyprocta leporina	1	-24.1	0.0	5.3	0.0	-26.9	0.0	1.8	0.0
Dasypus novemcinctus	4	-23.9	2.5	8.5	0.8	-26.0	2.5	5.3	0.8
Didelphis aurita	7	-23.5	1.9	7.5	0.4	-26.2	1.9	4.0	0.4
Eira barbara	1	-28.5	0.0	5.5	0.0	-31.4	0.0	1.5	0.0
Galictis cuja	1	-30.0	0.0	6.4	0.0	-32.2	0.0	2.7	0.0
Hydrochoerus hydrochaeris	2	-21.8	2.7	5.1	0.6	-24.6	2.7	1.7	0.6
Leopardus guttulus	3	-22.0	1.0	9.6	0.6	-24.2	1.0	6.2	0.6
Leopardus pardalis	3	-22.2	0.8	9.4	0.9	-24.4	0.8	5.9	0.9
Leopardus wiedii	2	-21.7	0.2	9.0	0.8	-23.9	0.2	5.5	0.8
Mazama sp.	8	-27.0	0.8	5.7	1.3	-30.1	0.8	1.8	1.3
Myrmecophaga tridactyla	1	-16.9	0.0	7.3	0.0	-19.0	0.0	4.0	0.0
Pecari tajacu	9	-25.8	1.2	5.8	1.7	-29.0	1.2	2.0	1.7
Puma concolor	24	-22.3	2.5	9.1	1.3	-24.5	2.5	5.6	1.3
Puma yagouaroundi	1	-23.6	0.0	9.4	0.0	-25.8	0.0	6.0	0.0
Sapajus nigritus	2	-21.9	4.9	7.4	1.6	-24.8	4.9	3.9	1.6
Sylvilagus brasiliensis	1	-23.2	0.0	2.7	0.0	-26.1	0.0	-0.6	0.0
Tamandua tetradactyla	2	-23.9	0.7	8.1	1.4	-26.0	0.7	4.9	1.4
Tapirus terrestris	11	-26.2	3.5	6.5	1.5	-29.3	3.5	2.9	1.5
Tayassy pecari	25	-25.6	1.2	5.1	1.6	-28.7	1.2	1.4	1.6
HMLs	**194**								
Cabassous tatouay	2	-20.4	1.4	9.2	1.1	-22.5	1.4	5.9	1.1
Cavia aperea	5	-12.2	1.4	6.5	2.6	-15.0	1.4	3.1	2.6
Cerdocyon thous	16	-17.8	4.6	8.6	1.5	-20.6	4.6	4.9	1.5
Chrysocyon brachyurus	23	-19.8	3.8	8.8	1.7	-22.6	3.8	5.1	1.7
Coendou spinosus	7	-20.7	5.7	6.9	2.2	-23.5	5.7	3.4	2.2
Cuniculus paca	3	-23.4	2.6	9.1	3.6	-26.3	2.6	5.7	3.6
Dasypus novemcintus	8	-21.7	1.4	7.5	1.0	-23.8	1.4	4.2	1.0
Didelphis albiventris	5	-20.8	3.3	8.2	2.2	-23.5	3.3	4.6	2.2
Galictis cuja	1	-21.0	0.0	9.6	0.0	-23.2	0.0	5.9	0.0
Hydrochoerus hydrochaeris	9	-12.0	1.4	9.1	0.9	-14.9	1.4	5.7	0.9
Leopardus guttulus	15	-17.9	4.8	9.0	1.4	-20.1	4.8	5.6	1.4

Table S1. Stable carbon and nitrogen isotopes values for mammals of the Atlantic Forest, state of São Paulo, Brazil. Corrected and uncorrected mean $\delta^{13}C$ and $\delta^{15}N$ values ± standard deviation (SD) for all mammal species analyzed in preserved areas and human-modified landscapes (HMLs), incluing the number of samples per species, and the total number of samples for each system.

Taxon	**N**	**Uncorrected (‰)**				**Corrected (‰)**			
		$\delta^{13}C$	**SD**	**$\delta^{15}N$**	**SD**	**$\delta^{13}C$**	**SD**	**$\delta^{15}N$**	**SD**
Leopardus pardalis	19	-18.4	4.8	8.6	1.5	-20.5	4.8	5.1	1.5
Leopardus wiedii	20	-18.0	5.2	8.6	1.2	-20.2	5.2	5.1	1.2
Mazama sp.	2	-26.7	0.7	6.9	1.4	-29.8	0.7	2.9	1.4
Nasua nasua	1	-22.3	0.0	9.0	0.0	-25.2	0.0	5.0	0.0
Puma concolor	30	-17.6	5.2	9.7	1.9	-19.8	5.2	6.3	1.9
Procyon cancrivorus	1	-21.8	0.0	9.4	0.0	-24.7	0.0	5.4	0.0
Puma yagouaroundi	23	-16.4	4.5	8.7	1.2	-18.6	4.5	5.3	1.2
Sylvilagus brasiliensis	3	-23.6	4.7	4.3	1.1	-25.2	5.3	1.8	0.3
Tamandua tetradactyla	1	-22.4	0.0	7.6	0.0	-24.5	0.0	4.3	0.0

Table S2. Variation in stable carbon and nitrogen isotopes values for mammals of the Atlantic Forest, state of São Paulo, Brazil. Minimum (Min), average (Avg), maximum (Max) and the range of $\delta^{13}C_{corrected}$ and $\delta^{15}N_{corrected}$ values considering all samples analyzed for mammal trophic guilds in preserved areas and human-modified landscapes (HMLs).

	$\delta^{15}C_{corrected}$ (‰)				$\delta^{15}N_{corrected}$ (‰)			
Trophic guilds	**Min**	**Avg**	**Max**	**Range**	**Min**	**Avg**	**Max**	**Range**
Preserved areas	**-32.6**	**-27.1**	**-18.1**	**14.5**	**-0.6**	**3.3**	**8.7**	**9.3**
Herbivores	-27.7	-26.3	-22.7	5.0	2.7	4.6	6.2	3.5
Frugivores	-32.6	28.9	-21.4	11.2	3.2	5.7	10.3	7.1
Omnivores	-31.4	-26.9	-22.6	8.8	5.5	7.3	8.0	2.5
Insectivores	-29.7	-25	-19.0	4.7	6.5	8.7	12.0	5.5
Carnivores	-32.2	-24.7	-18.1	14.1	6.4	9.1	11.4	5.0
HMLs	**-31.3**	**-20.6**	**-11.6**	**19.7**	**3.0**	**5.1**	**13.9**	**10.9**
Herbivores	-31.3	-18.7	-12.6	18.7	3.0	7.3	10.4	7.4
Frugivores	-30.3	-27.7	-23.3	7.0	5.8	8.2	13.3	7.5
Omnivores	-28.3	-22.1	-12.1	16.2	5.4	8.7	11.7	6.3
Insectivores	-25.5	-23.6	-21.3	4.2	6.0	7.8	10.0	4.0
Carnivores	-28.2	-19.8	-11.6	16.6	6.0	9.0	13.9	7.9

Table S3. $\delta^{15}N$ values of mammals of the Atlantic Forest, state of São Paulo, Brazil. Mean $\delta^{15}N_{corrected}$ values ± standard deviation (SD) for C_3, mixed and C_4 groups of each mammal trophic guilds, and considering all samples analyzed, in preserved areas and human-modified landscapes (HMLs).

Trophic guilds	**$\delta^{15}N_{corrected}$ (‰)**					
	C_3	**SD**	**Mixed**	**SD**	**C_4**	**SD**
Preserved areas	**2.2**	**1.6**	**5.6**	**1.3**	-	-
Herbivores	1.1	0.9	2.1	0.0	-	-
Frugivores	1.8	1.3	5.3	1.2	-	-
Omnivores	3.6	1.1	4.0	0.4	-	-
Insectivores	5.3	0.3	5.4	1.7	-	-
Carnivores	4.5	1.4	6.0	0.9	-	-
HMLs	**3.7**	**1.7**	**5.2**	**1.7**	**5.4**	**1.6**
Herbivores	2.0	1.4	3.1	2.2	4.8	2.0
Frugivores	3.3	1.0	9.8	0.0	-	-
Omnivores	3.5	1.6	5.1	1.7	5.5	0.9
Insectivores	-	-	4.5	1.1	-	-
Carnivores	5.0	1.3	5.5	1.6	5.6	1.5

Table S4. Sampling sites in preserved areas of the Atlantic Forest, state of São Paulo, Brazil.

Identification	Coordinates	Area (ha)
Núcleo Santa Virgínia	23º17'-23º24'S / 45º03'-40º11'W	17,000
Carlos Botelho State Park	24°00'-24°15'S / 47°45'-48°10'W	37,794
Intervales State Park	24º12'-24º32'S / 48º03'-48º32'W	41,705

Table S5. Sampling sites in human-modified landscapes (HMLs) of the Atlantic Forest, state of São Paulo, Brazil. Study areas in the Metropolitan region of Campinas (eight forest remnants) and Botucatu region (two remnants), including geographic coordinates and the area of the forest remnants (in ha).

Identification	Coordinates	Area (ha)
Metropolitan region of Campinas		
Pirapitingui (F1)	22°38'45"S / 47°08'59"W	44.9
Jaguari (F2)	22°41'43"S / 47°06'38"W	45.6
Bom Retiro (F3)	22°34'24"S / 47°06'13"W	59.5
Holandês (F4)	22°39'20"S / 47°06'37"W	64.7
International Paper (F5)	22°33'21"S / 47°05'10"W	73.1
ARIE Matão Cosmópolis (F6)	22°37'36"S / 47°08'06"W	164.3
Mata da Meia Lua (F7)	22°42"45"S / 47°05'50"W	204.6
ARIE Mata de Santa Genebra (F8)	22°49'13"S / 47°06'37"W	234.1
Botucatu region		
Fazenda Experimental Edgárdia (FEE)	22º48'59"S / 48º24'17"W	791
Unidade de Manejo Florestal Turvinho (UMFT)	22º45'58"S / 49º02'05"W	5,000 (entire area, including native and planted forest)

Table S6. Fractionation factors and trophic guilds of mammals at the Atlantic Forest, state of São Paulo, Brazil. Mean fractionation factors and standard deviation (SD) for stable carbon ($\Delta^{13}C$) and nitrogen ($\Delta^{15}N$) isotopes estimated by the SIDER package (20), available in R 3.4.3 (21), and trophic guilds (11, 23) for medium- and large-sized mammals in preserved areas and human-modified landscapes.

Taxon	Trophic guilds	$\Delta^{13}C$	SD	$\Delta^{15}N$	SD
Galictis cuja	Carnivore	2.2	1.9	3.7	1.5
Leopardus guttulus	Carnivore	2.2	1.9	3.4	1.5
Leopardus pardalis	Carnivore	2.2	1.9	3.5	1.5
Leopardus wiedii	Carnivore	2.2	1.9	3.4	1.5
Puma concolor	Carnivore	2.2	1.9	3.4	1.5
Puma yagouaroundi	Carnivore	2.2	1.9	3.4	1.5
Cuniculus paca	Frugivore	2.9	1.9	3.5	1.5
Dasyprocta azarae	Frugivore	2.9	1.9	3.4	1.5
Dasyprocta lepoporina	Frugivore	2.9	1.9	3.5	1.5
Pecari tajacu	Frugivore	3.1	1.8	3.8	1.4
Sapajus nigritus	Frugivore	2.9	1.9	3.5	1.5
Tayassu pecari	Frugivore	3.2	1.2	3.7	1.5
Tapirus terrestris	Frugivore / Herbivore	3.0	1.9	3.6	1.5
Mazama sp.*	Frugivore /Herbivore	3.1	1.7	3.9	1.3
Cavia aperae	Herbivore	2.8	1.9	3.4	1.5
Coendou spinosus	Herbivore	2.8	1.9	3.5	1.5
Hydrochoerus hydrochaeris	Herbivore	2.8	1.9	3.4	1.5
Silvilagus brasiliensis	Herbivore	2.9	1.8	3.3	1.4
Cabassous tatouay	Insectivore	2.1	1.9	3.3	1.6
Dasypus novemcinctus	Insectivore	2.1	2.0	3.3	1.6
Myrmecophaga tridactyla	Insectivore	2.1	2.0	3.3	1.6
Tamandua tetradactyla	Insectivore	2.1	2.0	3.3	1.6
Cerdocyon thous	Omnivore	2.8	1.8	3.7	1.4
Chrysocyon brachyurus	Omnivore	2.8	1.8	3.7	1.3
Didelphis albiventris	Omnivore	2.7	2.1	3.6	1.8
Didelphis aurita	Omnivore	2.7	2.1	3.6	1.8
Eira barbara	Omnivore	2.9	1.8	4.1	1.5
Nasua nasua	Omnivore	3.0	1.9	4.0	1.5
Procyon cancrivorus	Omnivore	2.9	1.8	4.0	1.5

* We used a mean fractionation factor based on the values estimated for species of genus *Mazama* that occurs in the study areas (*M. americana*, *M. bororo* and *M. goazoubira*), since it is not possible to differentiate species using hair microstructure.

References

1. Joly CA, Aidar MP, Klink CA, McGrath DG, Moreira AG, Moutinho P, Nepstad DC, Oliveira AA, Pott A, Rodal MJN, Sampaio EVSB (1999) Evolution of the Brazilian phytogeography classification systems: implications for biodiversity conservation. *Cien Cult* 51:331-348.
2. Oliveira-Filho AT, Fontes MAL (2000) Patterns of floristic differentiation among Atlantic Forests in Southeastern Brazil and the influence of climate. *Biotropica* 32:793-810.
3. Silva DMLD (2005) *Dinâmica de nitrogênio em microbacias no Estado de São Paulo*. Thesis, Universidade de São Paulo, Piracicaba.
4. Vitória AP, Ávila-Lovera E, Vieira TO, Couto-Santos APL, Pereira TJ, Funch LS, Freitas L, Miranda LDP, Rodrigues PJFP, Rezende CE, Santiago LS (2018) Isotopic composition of leaf carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) of deciduous and evergreen understory trees in two tropical Brazilian Atlantic forests. *J Trop Ecol* 34: 145-156.
5. Ribeiro MC, Metzger JP, Martensen AC, Ponzoni FJ, Hirota MM (2009) The Brazilian Atlantic Forest: how much is left, and how is the remaining forest distributed? Implications for conservation. *Biol Conserv* 142:1141–1153.
6. Still CJ, Berry JA, Collatz GJ, DeFries RS (2003) Global distribution of C_3 and C_4 vegetation: Carbon cycle implications. *Global Biogeochem Cycles* 17: 1006.
7. Powell RL, Still CJ (2009) Biogeography of C_3 and C_4 vegetation in South America. *XIV Simpósio Brasileiro Sensoriamento Remoto* 14: 2935-2942.
8. Galetti M et al. (2017) Defaunation and biomass collapse of mammals in the largest Atlantic forest remnant. *Anim Conserv* 20:270-281.
9. Ribeiro MC, Metzger JP, Martensen AC, Ponzoni FJ, Hirota MM (2009) The Brazilian Atlantic Forest: how much is left, and how is the remaining forest distributed? Implications for conservation. *Biol Conserv* 142:1141–1153.
10. Joly CA, Metzger JP, Tabarelli M (2014) Experiences from the Brazilian Atlantic Forest: ecological findings and conservation initiatives. *New Phytol* 204:459–473.
11. Magioli M, Ferraz KMPMB, Setz EZF, Percequillo AR, Rondon MVSS, Kuhnen VV, Canhoto MCS, Santos KEA, Kanda CZ, Fregonezi GL, Prado HA, Ferreira MK, Ribeiro MC, Villela PMS, Coutinho LL, Rodrigues MG (2016) Connectivity maintain mammal assemblages functional diversity within agricultural and fragmented landscapes. *Eur J Wildl Res* 62:431-446.
12. Magioli M, Bovo AAA, Alberici V, Ferraz KMPMB (2019) The use of hair traps as a complementary method in mammal ecology studies. *Mammalia* 83:144-149.
13. Korschgen LJ (1980) Procedures for food-habits analyses. Wildlife management techniques manual, ed Schamnitz, SD (The Wildlife Society, Washington) pp 113–127.
14. Quadros J (2002) *Identificação microscópica de pelos de mamíferos e sua aplicação no estudo da dieta de carnívoros*. Thesis, Universidade Federal do Paraná, Curitiba.
15. Miranda GHB, Rodrigues FHG, Paglia AP (2014) *Guia de identificação de pelos de mamíferos brasileiros* (Ciências Forenses, Brasília).
16. Amaro SC (2016) *Guia ilustrado para a identificação de mamíferos brasileiros de médio e grande porte a partir da microestrutura de pelos*. Monograph, Universidade de Vila Velha, Vila Velha.

17. Thompson AH, Wilson AS, Ehleringer JR (2013) Hair as a geochemical recorder: ancient to modern. *Treatise on Geochemistry: Second Edition*, eds Holland H, Turekian K (Elsevier Inc) pp. 371-393.
18. Magioli M et al. (2014) Stable isotope evidence of *Puma concolor* (Felidae) feeding patterns in agricultural landscapes in southeastern Brazil. *Biotropica* 46:451–460.
19. Galetti M, Rodarte RR, Neves CL, Moreira M, Costa-Pereira R (2016) Trophic niche differentiation in rodents and marsupials revealed by stable isotopes. *PloS One* 11:e0152494.
20. Healy K, Guillerme T, Kelly S, Inger R, Bearhop S, Jackson AL (2018) SIDER: an R package for predicting trophic discrimination factors of consumers based on their ecology and phylogenetic relatedness. *Ecography* 41:1393-1400.
21. R Core Team (2018) R: *A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria, https://www.R-project.org.
22. Jackson AL, Inger R, Parnell AC, Bearhop S (2011) Comparing isotopic niche widths among and within communities: SIBER–Stable Isotope Bayesian Ellipses in R. *J Anim Ecol* 80:595-602.
23. Paglia AP, Fonseca GAB, Rylands AB, Hermann G, Aguiar LMS, Chiarello AG, Leite YLR, Costa LP, Siciliano S, Kierulff MCM, Mendes SL, Tavares VC, Mittermeier RA, Patton JL (2012) Annotated Checklist of Brazilian Mammals. 2nd ed. *Occas Pap Conserv Biol* 6. Conservation International, Arlington, VA.