SPATIO-TEMPORAL PATTERNS OF MAMMAL ROAD MORTALITY IN MIDDLE MAGDALENA VALLEY, COLOMBIA

Fabio Leonardo Meza-Joya[1,2*], *Eliana Ramos*[1,2] & *Diana Cardona*[1]

[1] Colombia Endémica, Asociación para el Estudio y la Conservación de los Recursos Naturales, Calle 35 # 24-28, Bucaramanga, CEP 680002, Santander, Colombia.

[2] Universidad Industrial de Santander, Escuela de Biología, Grupo de Investigación en Biotecnología Industrial y Biología Molecular, Parque Tecnológico Guatiguará, Km 2 vía al Refugio, Piedecuesta, CEP 681011, Santander, Colombia.

E-mails: fabio.meza@correo.uis.edu.co (*corresponding autor); elianar86@gmail.com; dianicardoni@gmail.com

Supplementary Material - Table S1. General description of the surveyed route segments, landscape, management, anthropogenic features (urbanization level), and wildlife roadkill management measures.

Route	Segment description	Length	Landscape description	Urbanization level	Management measures
DR01	2–lane paved road; narrow to absent shoulder, some roadside ditches; speed limit 80 km/h	26 km	Smooth hills dominated by oil exploration and extraction areas, pastures, herbaceous and shrubby vegetation	Suburban	Warning signs
NR45	2–lane paved road; wide shoulder; discontinuous roadside ditches; speed limit 100 km/h	18 km	Smooth hills and plains dominated by pastures, heterogeneous agricultural areas, herbaceous and shrubby vegetation, and forest patches	Rural	None
NR66	2–lane paved road; wide to absent shoulder, intermittent roadside ditches; speed limit 100 km/h	31 km	Smooth hills dominated by pastures, heterogeneous agricultural areas, small forest patches, and dump and construction sites	Rural	None

Supplementary Material - Table S2. Resistance values assigned to different landscape features in the study area.

Group	Corine Land Cover (CLC) class	Resistance Value
Artificial surfaces	Continuous urban fabric	100
	Discontinuous urban	90
	Industrial or commercial units	100
	Road network	100
	Airports	100
	Mineral extraction sites	70
	Green urban areas	90
	Sport and leisure facilities	90
Agricultural areas	Permanent arboreal crops	10
	Grassland prevailingly without trees and shrubs	40
	Grassland with trees and shrubs	20
	Crops mosaic	30
	Grassland and Crops mosaic	30
	Crops, Grassland and natural vegetation mosaic	10
	Grassland and natural vegetation mosaic	10
	Crops and natural vegetation mosaic	10
Forest and semi–natural areas	Forest	1
	Gallery forest and riparian formations	1
	Agroforestry	10
	Herbaceous vegetation associations	30
	Shrub areas	10
	Secondary vegetation	1
Water bodies	River	40
	Inland wetlands	50
	Large water bodies	90

Fragmentation index		Resistance Value
Less Fragmentation	0–9	1–10
	9–15	10–20
	15–21	20–30
	21–26	30–40
	26–32	40–50
	32–39	50–60
	39–46	60–70
	46–54	70–80
	54–75	80–90
More Fragmentation	75–101	90–100

Proximity to rivers (m)		Resistance Value
Closer to river	0–21.46	1–10
	21.46–64.37	10–20
	64.37–107.29	20–30
	107.29–171.66	30–40
	171.66–236.03	40–50
	236.03–300.40	50–60
	300.40–386.23	60–70
	386.23–514.10	70–80
	514.10–793.92	80–90
Further from river	793.92–5,471.61	90–100

NDVI		Resistance Value
More greenness	0.53–0.67	1–10
	0.49–0.53	10–20
	0.44–0.49	20–30
	0.39–0.44	30–40
	0.32–0.39	40–50
	0.23–0.32	50–60
	0.12–0.23	60–70
	-0.01–0.12	70–80
	-0.19—0.01	80–90
Less greenness	-0.28—0.18	90 –100

Proximity to roads (m)		Resistance Value
Far from roads	10,000–6,313.67	1–10
	6,313.67–4,745.05	10–20
	4,745.05–3,686.24	20–30
	3,686.24–2,823.50	30–40
	2,823.50–2,078.41	40–50
	2,078.41–1,529.40	50–60
	1,529.40–1,098.03	60–70
	1,098.03–745.10	70–80
	745.10–156.86	80–90
Closer to roads	156.86–0.00	90 –100

Surface temperature (ºC)		Resistance Value
Less temperature	19.96–23.81	1–10
	23.81–24.18	10–20
	24.18–24.55	20–30
	24.55–24.91	30–40
	24.91–25.22	40–50
	25.22–25.59	50–60
	25.59–26.01	60–70
	26.01–26.57	70–80
	26.57–27.42	80–90
More temperature	27.42–35.56	90–100

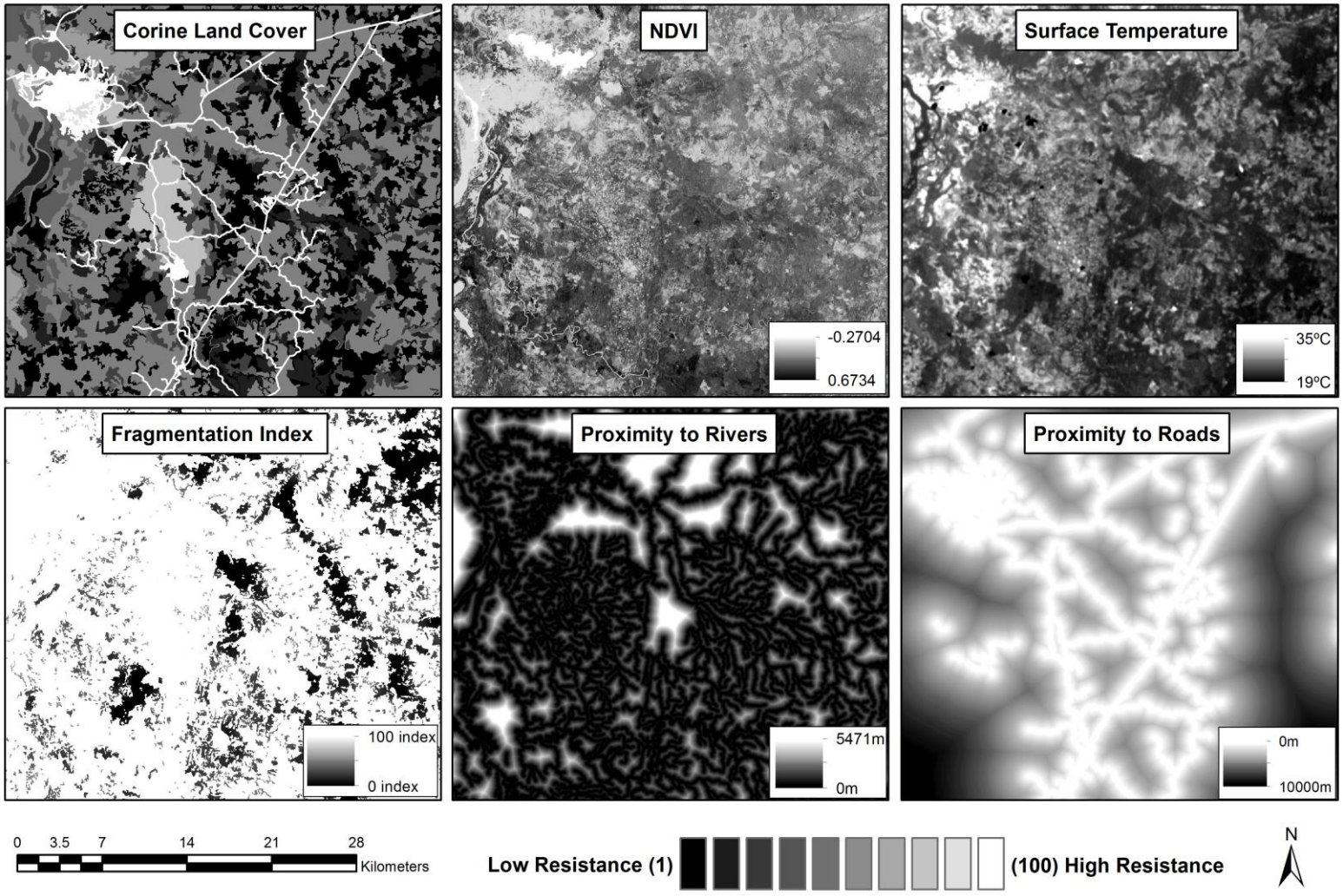
Supplementary Material - Table S3. Current density statistics from 100-m circular buffers around each roadkill location. Low landscape connectivity (< 0.50 amperes), high landscape connectivity (> 0.50, gray highlighted). *Mortality events associated to roadkill hotspots.

Roadkill ID	Scientific name	Current density values (amperes)					Roadkill location	
		Minimum	Maximum	Range	Mean	SE	Latitude	Longitude
1*	*Didelphis marsupialis*	0.32	0.35	0.03	0.33	0.01	7.00305	-73.78177
2*	*Didelphis marsupialis*	0.31	0.34	0.03	0.32	0.01	6.95844	-73.77250
3*	*Sciurus granatensis*	0.33	0.35	0.02	0.34	0.01	7.00366	-73.78190
4	*Tamandua mexicana*	0.43	0.45	0.02	0.44	0.00	7.04627	-73.80898
5	*Didelphis marsupialis*	0.48	0.74	0.32	0.57	0.07	6.97162	-73.69973
6	*Cerdocyon thous*	0.46	0.55	0.09	0.50	0.02	7.08628	-73.63430
7	*Cerdocyon thous*	0.55	0.58	0.03	0.56	0.01	7.09044	-73.70628
8	*Cerdocyon thous*	0.44	0.45	0.01	0.45	0.00	7.09044	-73.70628
9	*Didelphis marsupialis*	0.44	0.50	0.06	0.47	0.02	7.06139	-73.74721
10	*Didelphis marsupialis*	0.45	0.48	0.03	0.47	0.01	7.04743	-73.78545
11	*Didelphis marsupialis*	0.41	0.45	0.04	0.42	0.01	7.04246	-73.82688
12	*Procyon cancrivorus*	0.49	0.53	0.05	0.51	0.01	7.10524	-73.62278
13	*Sciurus granatensis*	0.41	0.49	0.08	0.44	0.02	7.01541	-73.79414
14	*Caluromys lanatus*	0.32	0.33	0.01	0.33	0.00	6.97080	-73.77582
15*	*Didelphis marsupialis*	0.35	0.40	0.05	0.38	0.01	7.01661	-73.81055
16	*Leopardus pardalis*	0.41	0.53	0.13	0.47	0.03	6.96879	-73.70013
17	*Didelphis marsupialis*	0.51	0.57	0.06	0.55	0.02	7.06883	-73.74021
18*	*Cerdocyon thous*	0.37	0.38	0.01	0.37	0.00	7.01679	-73.80697
19*	*Didelphis marsupialis*	0.39	0.39	0.00	0.39	0.00	7.01661	-73.81053
20	*Didelphis marsupialis*	0.42	0.43	0.02	0.43	0.00	7.04466	-73.77919
21	*Didelphis marsupialis*	0.42	0.42	0.00	0.42	0.00	7.04388	-73.77232
22	*Procyon cancrivorus*	0.52	0.58	0.06	0.55	0.01	7.10693	-73.66148
23	*Didelphis marsupialis*	0.44	0.45	0.01	0.45	0.00	7.04741	-73.80083
24	*Tamandua mexicana*	0.30	0.34	0.03	0.32	0.01	6.97871	-73.77549
25	*Didelphis marsupialis*	0.62	0.68	0.06	0.64	0.01	7.09891	-73.69300
26	*Procyon cancrivorus*	0.62	0.65	0.03	0.64	0.01	7.09860	-73.69334
27	*Procyon cancrivorus*	0.61	0.67	0.06	0.63	0.01	7.09860	-73.69334
28	*Procyon cancrivorus*	0.47	0.52	0.04	0.49	0.01	7.07613	-73.72878
29	*Didelphis marsupialis*	0.44	0.47	0.03	0.45	0.01	7.04322	-73.82140
30	*Cerdocyon thous*	0.32	0.39	0.06	0.34	0.01	7.01258	-73.67773
31	*Cerdocyon thous*	0.38	0.44	0.06	0.40	0.02	7.04325	-73.65973

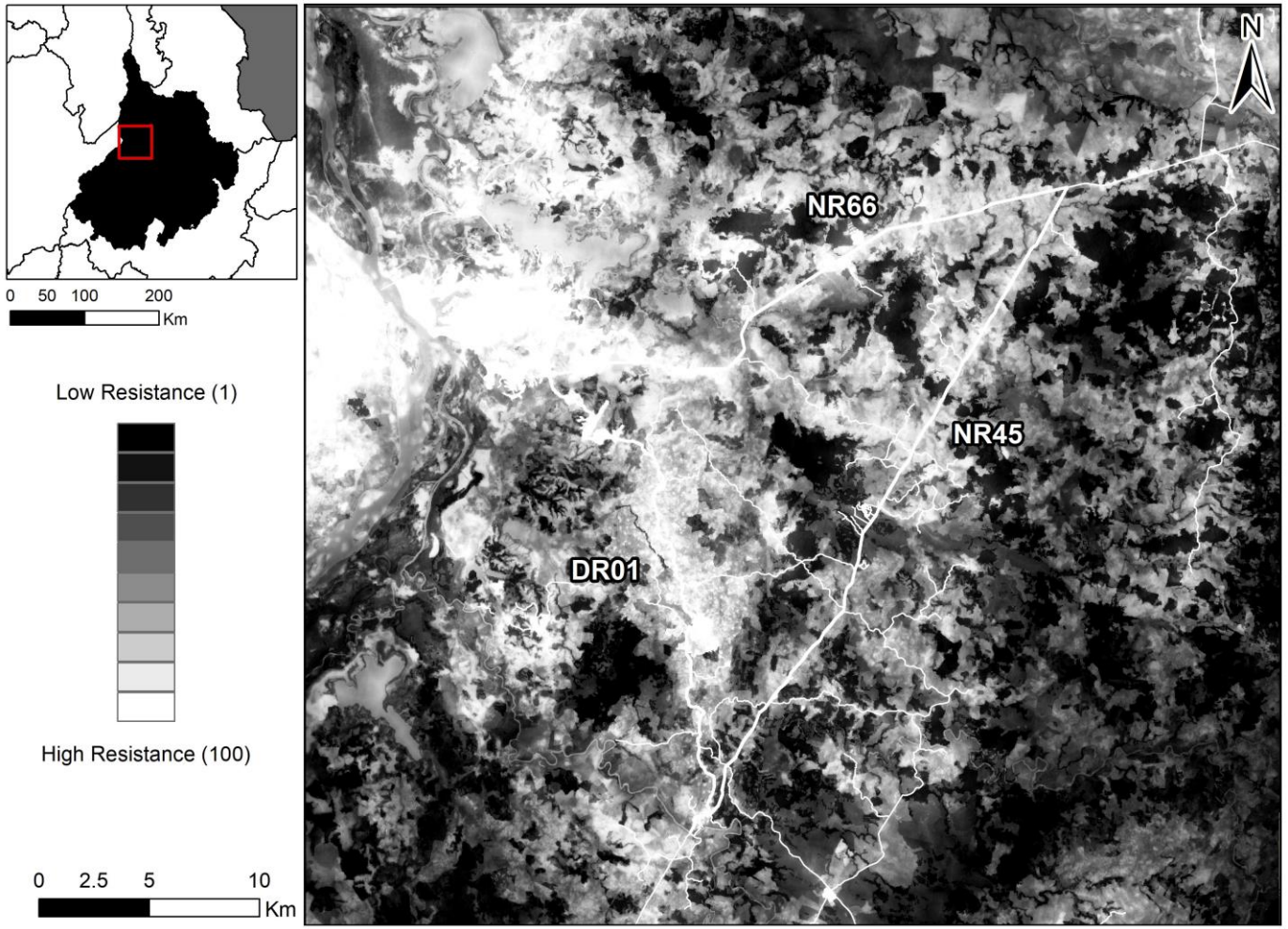
32	*Galictis vittata*	0.37	0.38	0.02	0.37	0.01	7.06240	-73.64847
33	*Tamandua mexicana*	0.50	0.65	0.15	0.57	0.04	7.09258	-73.63059
34*	*Tamandua mexicana*	0.34	0.37	0.03	0.35	0.01	7.00894	-73.78384
35*	*Sciurus granatensis*	0.33	0.35	0.02	0.34	0.01	7.00828	-73.78356
36*	*Didelphis marsupialis*	0.31	0.33	0.02	0.32	0.01	6.98277	-73.78200
37*	*Didelphis marsupialis*	0.31	0.33	0.02	0.32	0.00	6.98046	-73.78211
38	*Didelphis marsupialis*	0.40	0.47	0.07	0.43	0.02	7.01630	-73.79813
39*	*Cerdocyon thous*	0.31	0.34	0.03	0.32	0.01	6.98481	-73.78220
40*	*Tamandua mexicana*	0.32	0.33	0.01	0.33	0.00	6.95879	-73.77284
41	*Cerdocyon thous*	0.38	0.50	0.13	0.41	0.03	7.02627	-73.80922
42	*Didelphis marsupialis*	0.31	0.33	0.01	0.31	0.00	6.99220	-73.78408
43	*Tamandua mexicana*	0.42	0.46	0.04	0.43	0.01	7.04856	-73.65690
44	*Cerdocyon thous*	0.53	0.57	0.04	0.55	0.01	7.11601	-73.62859
45	*Cerdocyon thous*	0.57	0.64	0.07	0.61	0.02	7.10221	-73.68643
46	*Procyon cancrivorus*	0.49	0.49	0.00	0.49	0.00	7.07614	-73.72878
47*	*Procyon cancrivorus*	0.34	0.37	0.03	0.35	0.01	7.00966	-73.78480
48	*Sciurus granatensis*	0.45	0.64	0.20	0.51	0.04	6.97951	-73.69758
49	*Tamandua mexicana*	0.31	0.32	0.01	0.32	0.00	7.00467	-73.68232
50	*Procyon cancrivorus*	0.38	0.40	0.02	0.38	0.01	7.04291	-73.65999
51	*Procyon cancrivorus*	0.41	0.43	0.02	0.42	0.01	7.04355	-73.65961
52	*Cerdocyon thous*	0.38	0.41	0.02	0.39	0.01	7.02330	-73.67130
53	*Cerdocyon thous*	0.46	0.46	0.00	0.46	0.00	7.08626	-73.63431
54	*Didelphis marsupialis*	0.42	0.46	0.03	0.44	0.01	7.02607	-73.66944
55	*Procyon cancrivorus*	0.49	0.60	0.10	0.56	0.03	7.10767	-73.62142
56	*Cerdocyon thous*	0.46	0.54	0.08	0.49	0.02	7.10346	-73.62372
57	*Didelphis marsupialis*	0.53	0.57	0.03	0.55	0.01	7.11513	-73.63255
58	*Tamandua mexicana*	0.50	0.55	0.06	0.53	0.02	7.11356	-73.63985
59	*Tamandua mexicana*	0.40	0.66	0.26	0.49	0.08	6.97698	-73.69877
60	*Tamandua mexicana*	0.49	0.56	0.07	0.52	0.02	7.03776	-73.63328
61	*Tamandua mexicana*	0.56	0.83	0.26	0.72	0.06	7.11069	-73.64854
62	*Didelphis marsupialis*	0.42	0.46	0.03	0.44	0.01	7.07679	-73.63994
63*	*Procyon cancrivorus*	0.33	0.35	0.02	0.34	0.01	7.00423	-73.78187
64*	*Sciurus granatensis*	0.31	0.36	0.04	0.33	0.01	6.98668	-73.78349
65	*Cerdocyon thous*	0.57	0.59	0.02	0.58	0.00	7.09162	-73.70437
66	*Tamandua mexicana*	0.61	0.67	0.06	0.63	0.01	7.10102	-73.68973
67	*Cerdocyon thous*	0.49	0.55	0.06	0.51	0.02	7.10875	-73.65416

68	*Caluromys lanatus*	0.41	0.44	0.03	0.43	0.01	7.03128	-73.81506
69	*Procyon cancrivorus*	0.30	0.33	0.03	0.31	0.01	6.94431	-73.76687
70*	*Procyon cancrivorus*	0.33	0.35	0.03	0.34	0.01	7.00511	-73.78222
71*	*Didelphis marsupialis*	0.33	0.33	0.01	0.33	0.00	7.00673	-73.78329
72	*Cerdocyon thous*	0.31	0.33	0.02	0.32	0.00	6.95166	-73.77200
73	*Tamandua mexicana*	0.48	0.48	0.00	0.48	0.00	7.10534	-73.62270
74	*Procyon cancrivorus*	0.53	0.71	0.18	0.58	0.04	7.07972	-73.72314
75	*Cerdocyon thous*	0.31	0.41	0.09	0.37	0.02	6.98832	-73.75795
76	*Cerdocyon thous*	0.31	0.33	0.02	0.32	0.00	6.98832	-73.75795
77	*Cerdocyon thous*	0.39	0.44	0.05	0.41	0.01	7.06743	-73.64512
78	*Procyon cancrivorus*	0.63	0.80	0.18	0.70	0.06	7.11482	-73.61747
79	*Cerdocyon thous*	0.43	0.51	0.07	0.45	0.02	7.01609	-73.79726
80	*Procyon cancrivorus*	0.47	0.50	0.02	0.49	0.01	7.08558	-73.71392
81	*Didelphis marsupialis*	0.49	0.65	0.16	0.56	0.04	7.02804	-73.81157
82	*Didelphis marsupialis*	0.24	0.30	0.03	0.28	0.01	6.90382	-73.76444
83	*Tamandua mexicana*	0.40	0.46	0.06	0.43	0.02	7.01448	-73.78968
84	*Tamandua mexicana*	0.34	0.45	0.10	0.38	0.02	6.99425	-73.68846
85	*Cerdocyon thous*	0.36	0.39	0.03	0.37	0.01	7.01912	-73.67430
86	*Procyon cancrivorus*	0.46	0.52	0.06	0.50	0.02	7.06033	-73.74766
87*	*Tamandua mexicana*	0.31	0.33	0.02	0.32	0.01	6.98174	-73.78215
88*	*Didelphis marsupialis*	0.32	0.35	0.02	0.33	0.01	7.00254	-73.78139
89*	*Didelphis marsupialis*	0.33	0.34	0.01	0.33	0.00	7.00708	-73.78338
90	*Didelphis marsupialis*	0.43	0.47	0.04	0.46	0.01	7.01464	-73.78999
91	*Didelphis marsupialis*	0.43	0.47	0.04	0.45	0.01	7.04335	-73.82027
92*	*Didelphis marsupialis*	0.31	0.33	0.02	0.32	0.00	7.00705	-73.78333
93*	*Cerdocyon thous*	0.38	0.44	0.06	0.42	0.01	6.95978	-73.77401
94	*Tamandua mexicana*	0.38	0.42	0.04	0.40	0.01	7.06952	-73.64409
95	*Tamandua mexicana*	0.40	0.86	0.46	0.59	0.10	7.06632	-73.64594
96	*Procyon cancrivorus*	0.62	0.63	0.02	0.62	0.01	6.96491	-73.70109
97	*Didelphis marsupialis*	0.46	0.52	0.06	0.50	0.02	7.10221	-73.68673
98	*Cerdocyon thous*	0.42	0.44	0.02	0.43	0.00	7.04503	-73.76592
99	*Didelphis marsupialis*	0.64	0.64	0.00	0.64	0.00	7.10213	-73.68678
100	*Tamandua mexicana*	0.77	1.34	0.57	0.94	0.13	7.11797	-73.61966
101	*Procyon cancrivorus*	0.45	0.48	0.03	0.46	0.01	7.04498	-73.75648
102	*Tamandua mexicana*	0.54	0.56	0.02	0.55	0.01	7.11598	-73.62817
103	*Didelphis marsupialis*	0.47	0.50	0.03	0.49	0.01	7.10503	-73.67095

104	*Tamandua mexicana*	0.58	0.63	0.06	0.60	0.01	7.09646	-73.69675
105	*Didelphis marsupialis*	0.43	0.46	0.03	0.44	0.01	7.04348	-73.81952
106	*Didelphis marsupialis*	0.47	0.57	0.10	0.51	0.00	7.10251	-73.62418
107	*Cerdocyon thous*	0.39	0.43	0.04	0.41	0.01	7.05155	-73.65486
108*	*Procyon cancrivorus*	0.32	0.32	0.01	0.32	0.00	6.97714	-73.78204
109	*Sciurus granatensis*	0.37	0.58	0.21	0.45	0.01	7.03389	-73.81944
110	*Cerdocyon thous*	0.43	0.52	0.10	0.48	0.03	6.96776	-73.70021
111	*Didelphis marsupialis*	0.43	0.45	0.02	0.44	0.01	7.04497	-73.76099
112	*Tamandua mexicana*	0.54	0.57	0.03	0.55	0.01	7.08910	-73.70836



Supplementary Material - Figure S1. Landscape features used for createating a resistance surface of the study area. Spatial resolution of 30 m.



Supplementary Material - Figure S2. Resistance surfaces of the study area representing the hypothesized relationships between environmental features and multi–scale structural connectivity. Spatial resolution of 30 m.