Supplementary Information

Connectivity of natural vegetation in a Cerrado–Pantanal ecological corridor declined nearly twice as fast as habitat area

David Albuquerque Aranha

Supplementary Table S1a. Sensitivity of the equivalent connected area (ECA) of natural vegetation to the minimum node size.

Minimum node size (ha)	d (m)	Nodes 2014	Nodes 2024	ECA 2014 (ha)	ECA 2024 (ha)	Change (%)
2	200	3334	3369	109,084	98,649	-9.6
2	1500	3334	3369	157,202	143,748	-8.6
2	5000	3334	3369	208,029	191,622	-7.9
10	200	1139	1144	107,086	97,347	-9.1
10	1500	1139	1144	146,677	133,166	-9.2
10	5000	1139	1144	194,253	175,509	-9.6
50	200	343	340	104,920	91,577	-12.7
50	1500	343	340	130,267	120,141	-7.8
50	5000	343	340	168,648	150,964	-10.5

Supplementary Table S1b. Sensitivity of core area to edge depth.

Edge depth (m)	Core area 2014 (ha)	Core area 2024 (ha)	Change (%)
60	181,861	170,495	-6.2
90	153,372	143,333	-6.5
150	116,518	108,535	-6.9

Supplementary Table S2. Monotonic trends of annual landscape and connectivity indicators, 2014–2024 (n = 11 years).

Habitat	Variable	2014	2024	Change (%)	Kendall τ	P	Sen slope (yr⁻¹)	Sen slope (% yr⁻¹)
Natural vegetation	Habitat area	261,548.7	247,902.7	-5.22	-1.00	<0.0001	-1,453.2	-0.56
Natural vegetation	Core area	153,372.2	143,333.1	-6.55	-1.00	<0.0001	-1,011.1	-0.66
Natural vegetation	Number of patches	7,919.0	8,273.0	+4.47	0.93	<0.0001	37.2	+0.47
Natural vegetation	Effective mesh size	7,830.2	7,179.9	-8.31	0.05	0.8793	12.2	+0.16
Natural vegetation	ECA, d = 200 m	107,085.6	97,346.5	-9.09	-0.78	0.0003	-874.8	-0.82
Natural vegetation	ECA, d = 500 m	121,195.2	110,668.0	-8.69	-0.85	<0.0001	-935.8	-0.77
Natural vegetation	ECA, d = 1500 m	146,676.9	133,165.7	-9.21	-1.00	<0.0001	-1,347.8	-0.92
Natural vegetation	ECA, d = 5000 m	194,252.6	175,509.3	-9.65	-1.00	<0.0001	-2,015.1	-1.04
Forest	Habitat area	174,559.7	171,417.4	-1.80	-0.85	<0.0001	-296.1	-0.17
Forest	Core area	66,117.3	63,260.6	-4.32	-0.96	<0.0001	-281.1	-0.43
Forest	Number of patches	10,520.0	10,747.0	+2.16	0.92	<0.0001	25.0	+0.24
Forest	Effective mesh size	904.7	868.7	-3.98	0.05	0.8793	0.8	+0.09
Forest	ECA, d = 200 m	42,569.9	41,865.5	-1.65	-0.31	0.2183	-46.9	-0.11

Habitat	Variable	2014	2024	Change (%)	Kendall τ	P	Sen slope (yr⁻¹)	Sen slope (% yr⁻¹)
Forest	ECA, d = 500 m	51,791.7	51,068.1	-1.40	-0.35	0.1646	-25.5	-0.05
Forest	ECA, d = 1500 m	70,399.0	68,852.1	-2.20	-0.53	0.0264	-82.9	-0.12
Forest	ECA, d = 5000 m	106,510.5	103,634.7	-2.70	-0.78	0.0003	-216.1	-0.20

Supplementary Table S3. The twenty most important patches for connectivity in 2024 (d = 1,500 m).

Rank	Area (ha)	dPC (%)	Intra (%)	Flux (%)	Connector (%)
1	69,755.4	78.37	27.44	43.73	7.20
2	13,366.0	27.72	1.01	16.30	10.42
3	11,697.2	14.97	0.77	10.86	3.34
4	4,588.2	6.62	0.12	6.06	0.44
5	1,807.7	5.71	0.02	1.62	4.07
6	3,144.5	4.62	0.06	4.09	0.48
7	220.9	4.43	0.00	0.24	4.20
8	3,061.1	4.30	0.05	4.07	0.18
9	2,601.6	3.84	0.04	2.25	1.55
10	4,058.1	3.45	0.09	1.27	2.09
11	1,029.2	3.23	0.01	1.35	1.88
12	7,667.9	2.61	0.33	2.05	0.22
13	913.2	2.33	0.00	1.09	1.23
14	10,370.5	2.26	0.61	1.64	0.01
15	1,318.9	2.15	0.01	1.74	0.41
16	187.9	1.85	0.00	0.17	1.68
17	13.1	1.61	0.00	0.02	1.59
18	2,940.8	1.48	0.05	0.79	0.64
19	2,100.5	1.46	0.02	0.56	0.87
20	1,432.4	1.44	0.01	0.49	0.94

Supplementary Table S4. Conversion rate (% of 2014 natural vegetation converted by 2024) by patch size and distance to the nearest edge.

Patch size in 2014 (ha)	<=30 m	31-90 m	91-300 m	301-1000 m	>1000 m
<10	24.0	17.0	14.1		
10-100	20.5	12.1	9.4	5.6	
100-1000	21.5	11.7	8.1	5.4	0.0
1000-10000	20.4	11.0	8.1	3.7	0.0
>10000	19.6	10.0	5.0	1.9	0.3

Supplementary Note S1. Spatial processes of landscape transformation

Processes were assigned with the decision tree of Bogaert et al. (2004, Environ. Manage. 33, 62–73) from the habitat area (a), perimeter (p) and number of patches (n) in 2014 (0) and 2024 (1) in each 5 × 5 km cell. Loss of habitat (a1 < a0): attrition when n1 < n0; shrinkage when n1 = n0 and p1 ≤ p0; perforation when n1 = n0 and p1 > p0; dissection when n1 > n0 and a1/a0 > 0.75; fragmentation when n1 > n0 and a1/a0 ≤ 0.75. Gain of habitat (a1 ≥ a0): aggregation when n1 < n0; enlargement when n1 = n0; creation when n1 > n0. Cells with a relative change in area below 0.5% and no change in the number of patches were labelled stable. Perimeter was computed only along interfaces with land use inside the corridor.

Supplementary Note S2. Systematic literature review (Parsifal–PRISMA 2020, five validation gates)

Question (PICOC). Population: natural vegetation remnants in Neotropical savanna and forest landscapes; intervention or exposure: conversion of natural vegetation to anthropic uses; comparison: multi-temporal change; outcomes: fragmentation metrics, structural or functional connectivity, corridor delineation and biotic responses to habitat amount and configuration; context: studies based on land-cover maps from satellite or aerial imagery. Inclusion criteria: IC01 addresses fragmentation, configuration or connectivity of natural vegetation; IC02 uses spatially explicit land-cover data (stratum A) or provides ecological or methodological evidence on habitat amount, configuration, edge effects or connectivity metrics (stratum B); IC03 Neotropical context for stratum A; IC04 peer-reviewed article or review published from 2005 to November 2026. Exclusion criteria: EC01 duplicate; EC02 outside the scope; EC03 context outside the protocol; EC04 no configuration or connectivity outcome; EC08 full text not retrieved after the planned attempts.

Searches (gate V2) were run on 11 November 2026 in OpenAlex, the index used by the open search of the CAPES Journal Portal, and in Semantic Scholar. Exact strings, filters and numbers of records are listed in Supplementary Table S5. Recall of a predefined set of 18 seed articles was 61.1% (11 retrieved); the target of 90% was not reached, because the missing seeds concern tropical forests or the Pantanal without explicit terms of fragmentation or connectivity in the title or abstract. These articles were added to the reference base from known literature, and the search strategy will be extended before the review is reported on its own. Duplicates were removed by normalized DOI and then by normalized title. Screening of titles and abstracts (gate V3) was performed by one reviewer; a stratified sample of 50 records was prepared for independent calibration by a second reviewer, and Cohen's κ will be reported once this calibration is complete. Full-text eligibility, quality assessment and extraction (gates V4 and V5) are in progress. The review informed the framing of the study and the choice of metrics and thresholds; no quantitative synthesis of its records is reported in the main text.

Supplementary Table S5. Search log.

ID	Database	Date and time	Exact query	Fields and filters	Records in database	Records exported
OA1	OpenAlex (CAPES Portal open search)	2026-11-11T08:19	(fragmentation OR "landscape connectivity" OR "habitat connectivity" OR "ecological corridor" OR "landscape metrics" OR "functional connectivity") AND (Cerrado OR Pantanal OR "Brazilian savanna" OR "tropical savanna") AND (MapBiomas OR Landsat OR "remote sensing" OR satellite OR "land cover" OR "land use")	title and abstract; 2005-2026; article|review	109	109
OA2	OpenAlex (CAPES Portal open search)	2026-11-11T08:19	("equivalent connected area" OR "probability of connectivity" OR "graph theory" OR "habitat availability") AND (Cerrado OR Pantanal OR savanna OR Brazil) AND (fragmentation OR connectivity)	title and abstract; 2005-2026; article|review	61	61

ID	Database	Date and time	Exact query	Fields and filters	Records in database	Records exported
OA3	OpenAlex (CAPES Portal open search)	2026-11-11T08:19	("forest fragments" OR "fragment size" OR "edge effects" OR "edge area") AND (loss OR deforestation) AND (tropical OR Brazil OR Cerrado) AND (Landsat OR satellite OR "remote sensing")	title and abstract; 2005-2026; article|review	72	72
S2_1	Semantic Scholar	2026-11-11T08:21	landscape fragmentation connectivity Cerrado remote sensing	relevance; 2005-2026; top 300	2233	100
S2_4	Semantic Scholar	2026-11-11T08:27	forest fragment loss edge effects tropical Landsat	relevance; 2005-2026; top 300	1011	100
S2_5	Semantic Scholar	2026-11-11T08:29	MapBiomas fragmentation landscape metrics native vegetation	relevance; 2005-2026; top 300	1117	100
OA6	OpenAlex (CAPES Portal open search)	2026-11-11T08:40	("small fragments" OR "fragment size" OR "edge effect") AND (deforestation OR "vegetation loss") AND (Brazil OR tropical)	title and abstract; 2005-2026; article|review	100	100
S2_2	Semantic Scholar	2026-11-11T08:50	ecological corridor habitat connectivity Pantanal Cerrado	relevance; 2005-2026; top 300	0	0
S2_3	Semantic Scholar	2026-11-11T08:53	equivalent connected area probability of connectivity Brazil	relevance; 2005-2026; top 300	19	19
OA4	OpenAlex (CAPES Portal open search)	2026-11-11T09:14	(fragmentation OR connectivity) AND (Cerrado OR Pantanal)	title and abstract; 2005-2026; article|review; paged export, complete	513	513
OA5	OpenAlex (CAPES Portal open search)	2026-11-11T09:15	("habitat amount" OR "fragmentation per se") AND (landscape OR habitat)	title and abstract; 2005-2026; article|review; paged export, complete	530	530
OA7	OpenAlex (CAPES Portal open search)	2026-11-11T09:16	("ecological corridor" OR "biodiversity corridor" OR "wildlife corridor") AND (Brazil OR Cerrado OR Pantanal)	title and abstract; 2005-2026; article|review; paged export, complete	205	205

Supplementary Figure S1. PRISMA 2020 flow diagram of the literature review.

