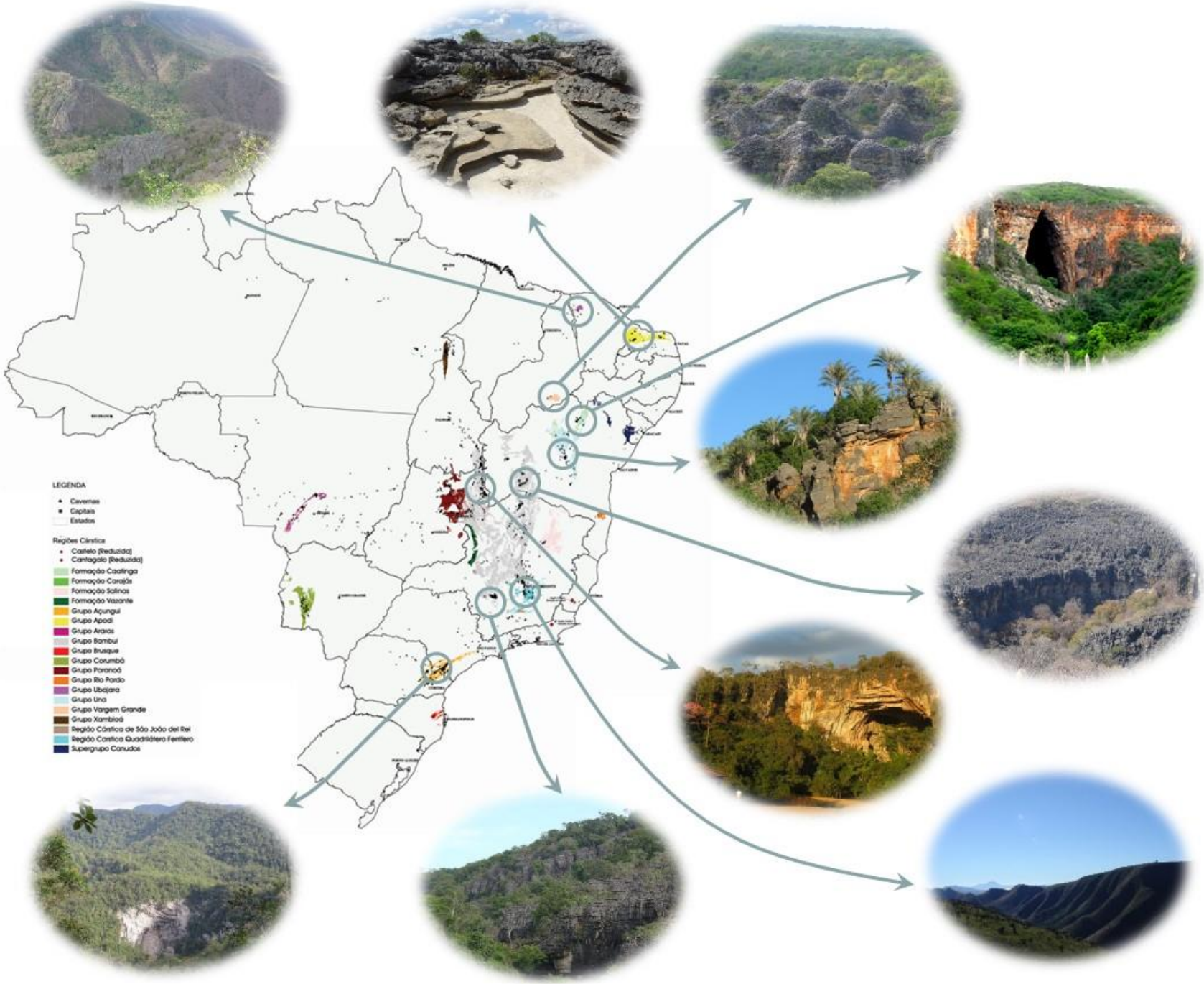
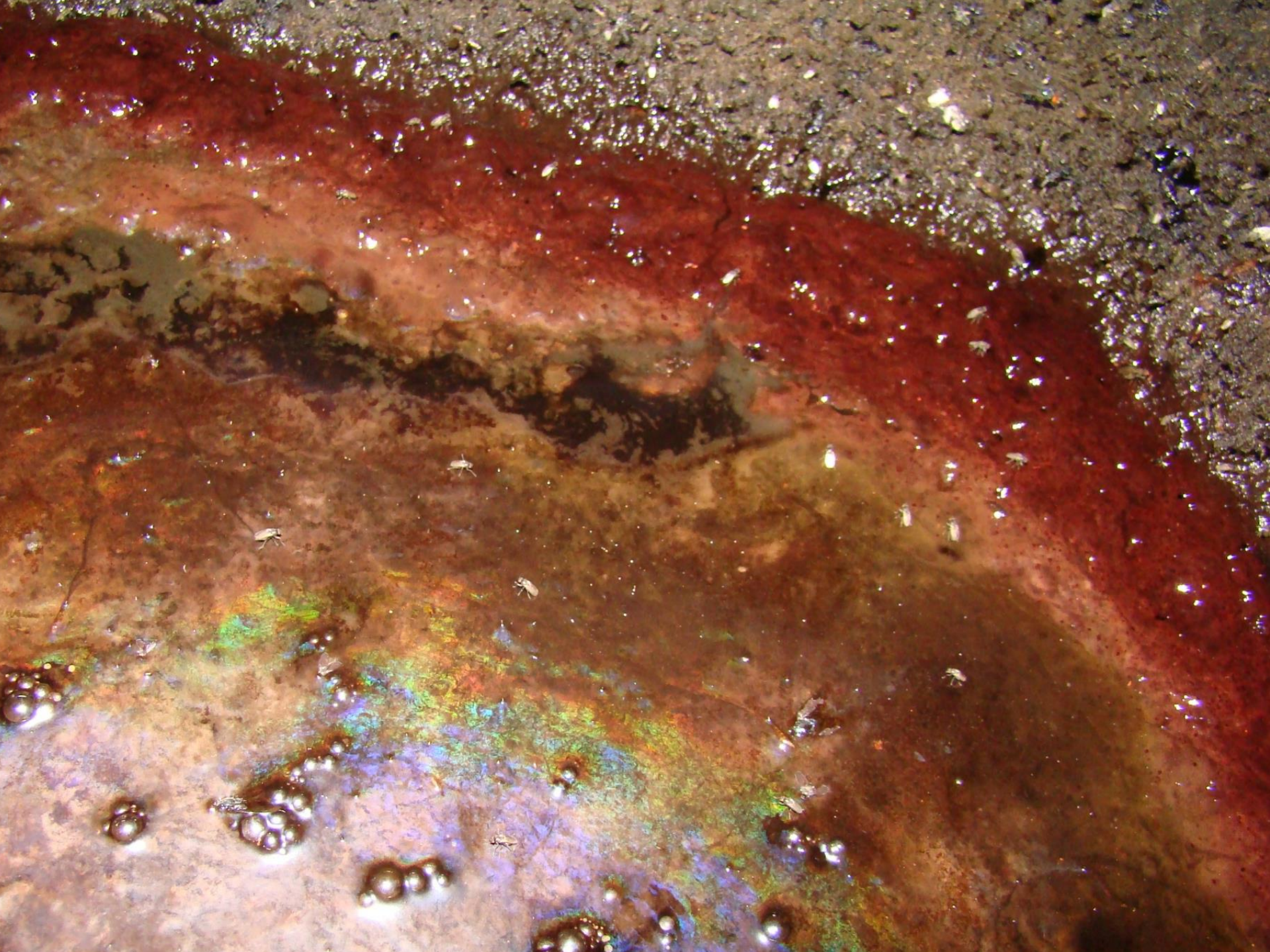
Saindo da redoma de cristal:

O papel das universidades em auxiliar políticas públicas e atuar na conservação efetiva do patrimônio espeleológico brasileiro


LEGENDA
Cavernas
Capitais
Estados
Regiões Cárstica
Castelo (Reduzida)
Cantagalo (Reduzida)
Formação Caatinga
Formação Carajás
Formação Salinas
Formação Vazante
Grupo Açungui
Grupo Apodi
Grupo Araras
Grupo Bambuí
Grupo Brusque
Grupo Corumbá
Grupo Paranoá
Grupo Rio Pardo
Grupo Ubajara
Grupo Una
Grupo Vargem Grande
Grupo Xambioá
Região Cárstica de São João del Rei
Região Carstica Quadrilátero Ferrifero
Supergrupo Canudos



Acidentais

Troglóxenos

Troglófilos


Troglóbios

Eukoenenia maquinensis Souza & Ferreira, 2010

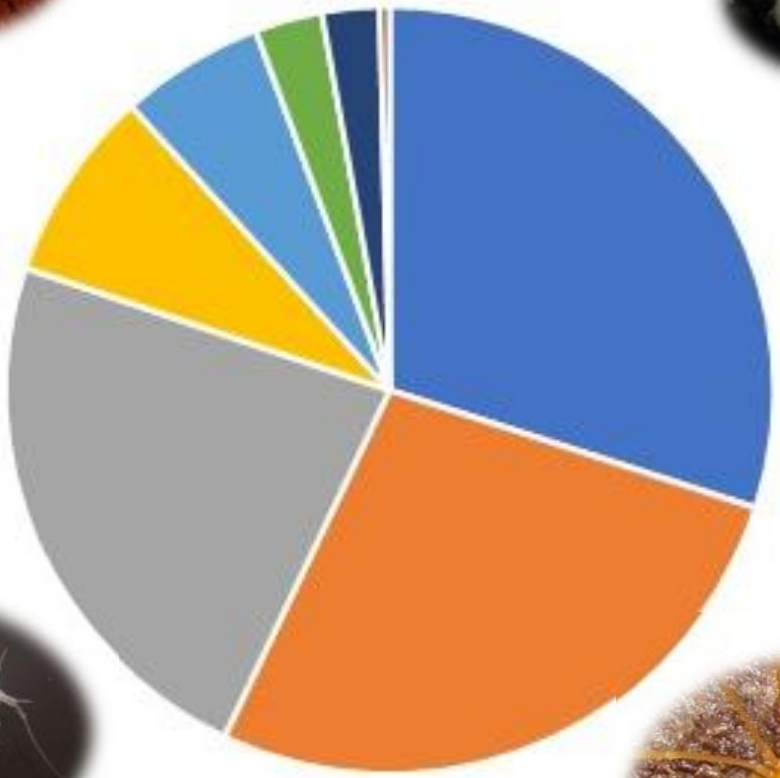
Ferricixius davidi Hoch & Ferreira, 2012

Iuiuiniscus iuiuensis Souza, Senna & Ferreira, 2015

Brasileirinho cavaticus Prevorčnik, Ferreira & Sket, 2012

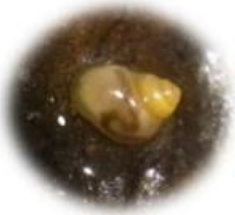
Dobrodesmus mirabilis Shear, Ferreira, Iniesta & Marek, 2016

246 espécies troglóbias descritas



Platyhelmintes
(2,98%)

Mollusca
(2,55%)



Myriapoda
(6,38%)

Porifera
(0,43%)

Pisces
(8,51%)

Hexapoda
(31,49%)

Crustacea
(24,26%)

Arachnida
(28,51%)

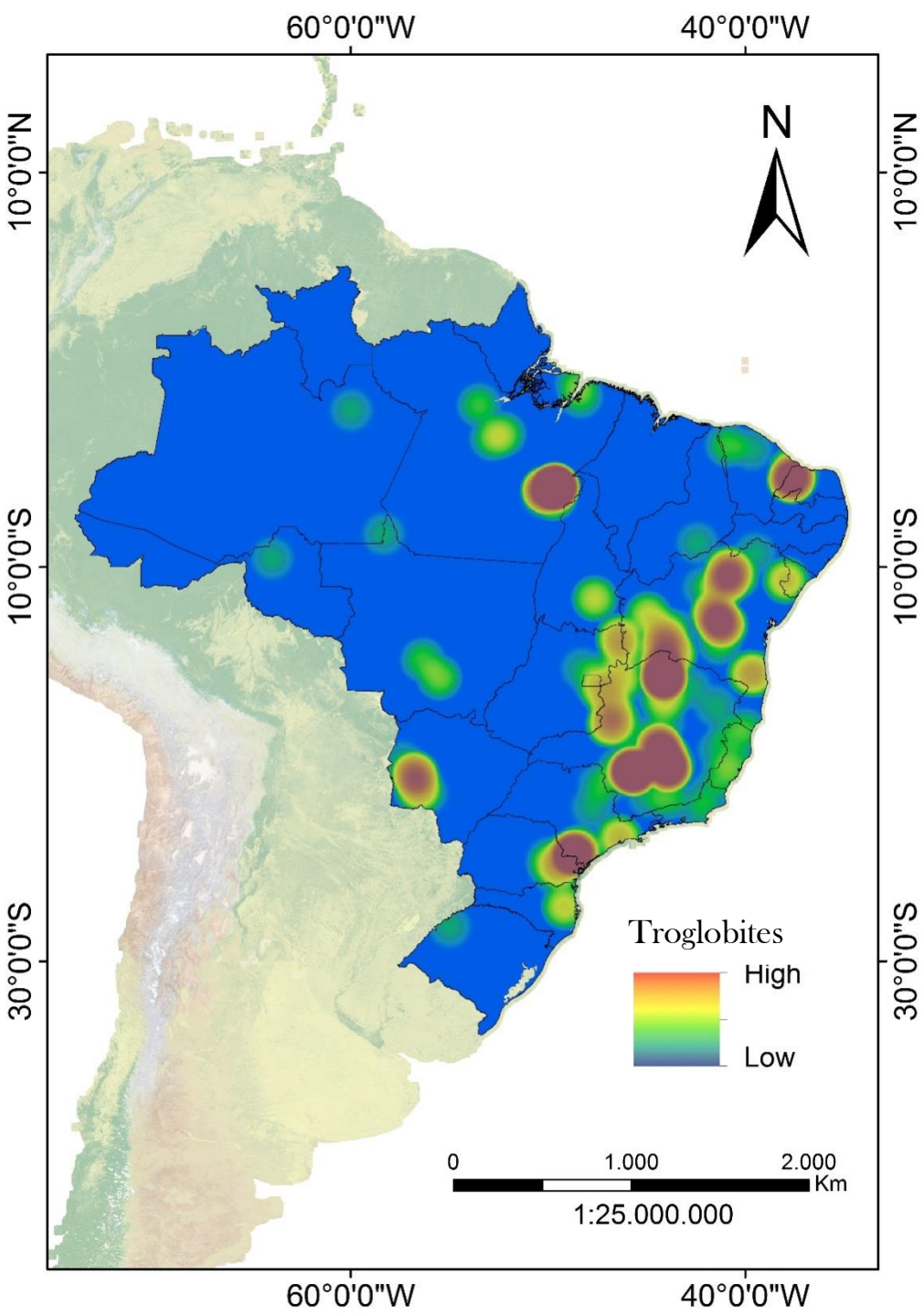

Espécies descritas
140
120
100
80
60
40
20
0
2008
1900-1905
1906-1910
1911-1915
1916-1920
1921-1925
1926-1930
1931-1935
1936-1940
1941-1945
1946-1950
1951-1955
1956-1960
1961-1965
1966-1970
1971-1975
1976-1980
1981-1985
1986-1990
1991-1995
1996-2000
2001-2005
2006-2010
2011-2015
2016-2020

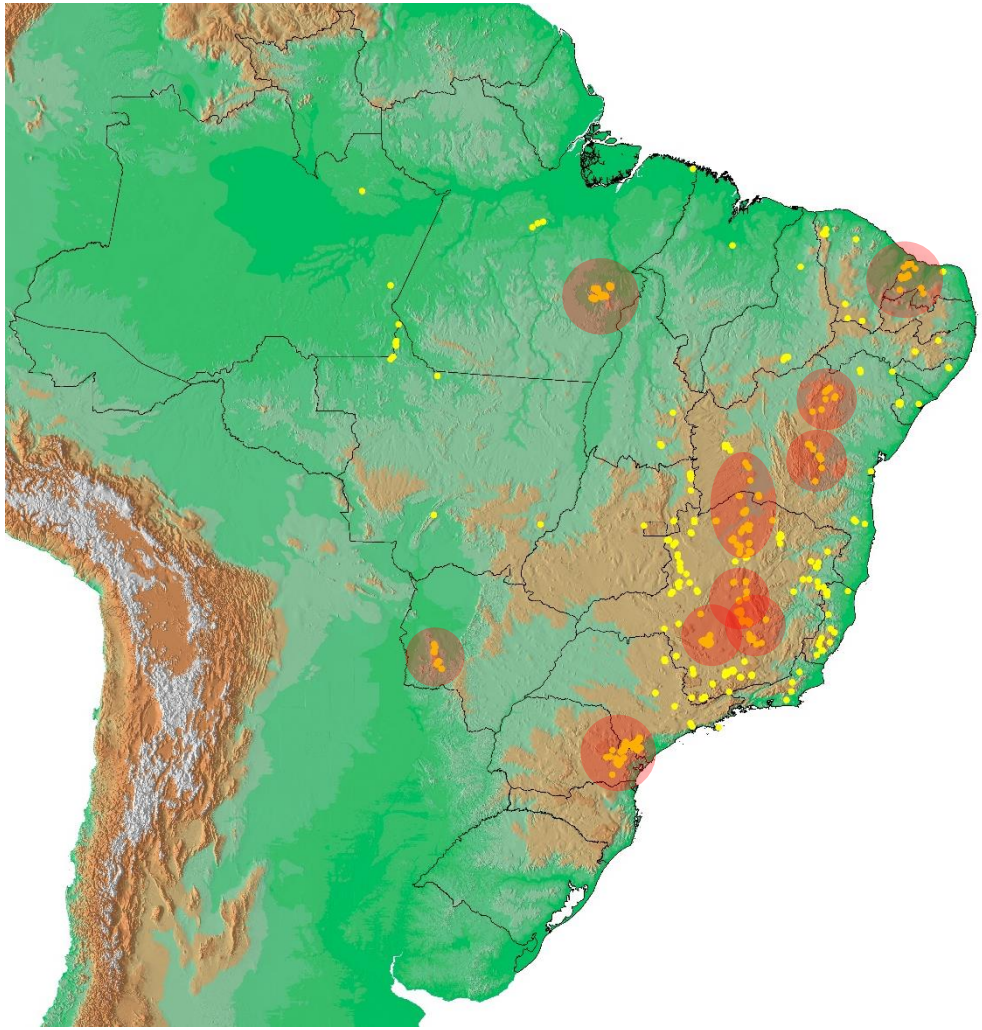
Decreto Nº 99556
(1990)

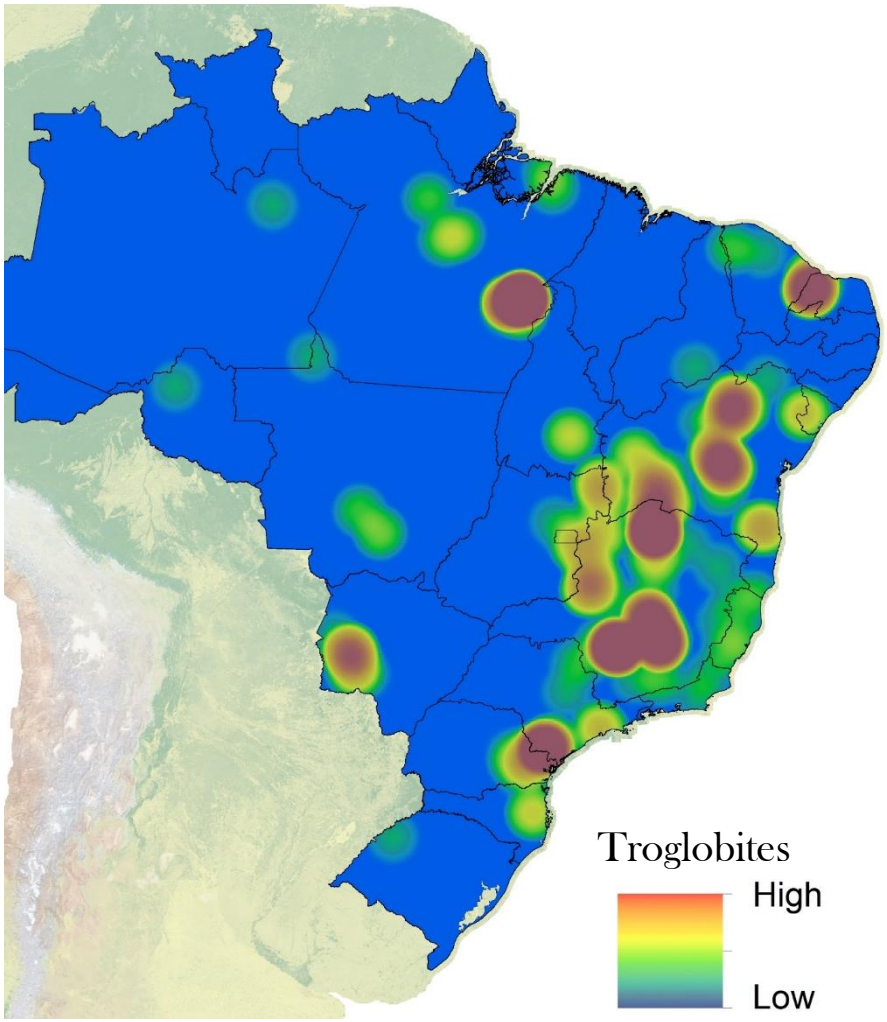
Decreto Nº 6640
(2008)

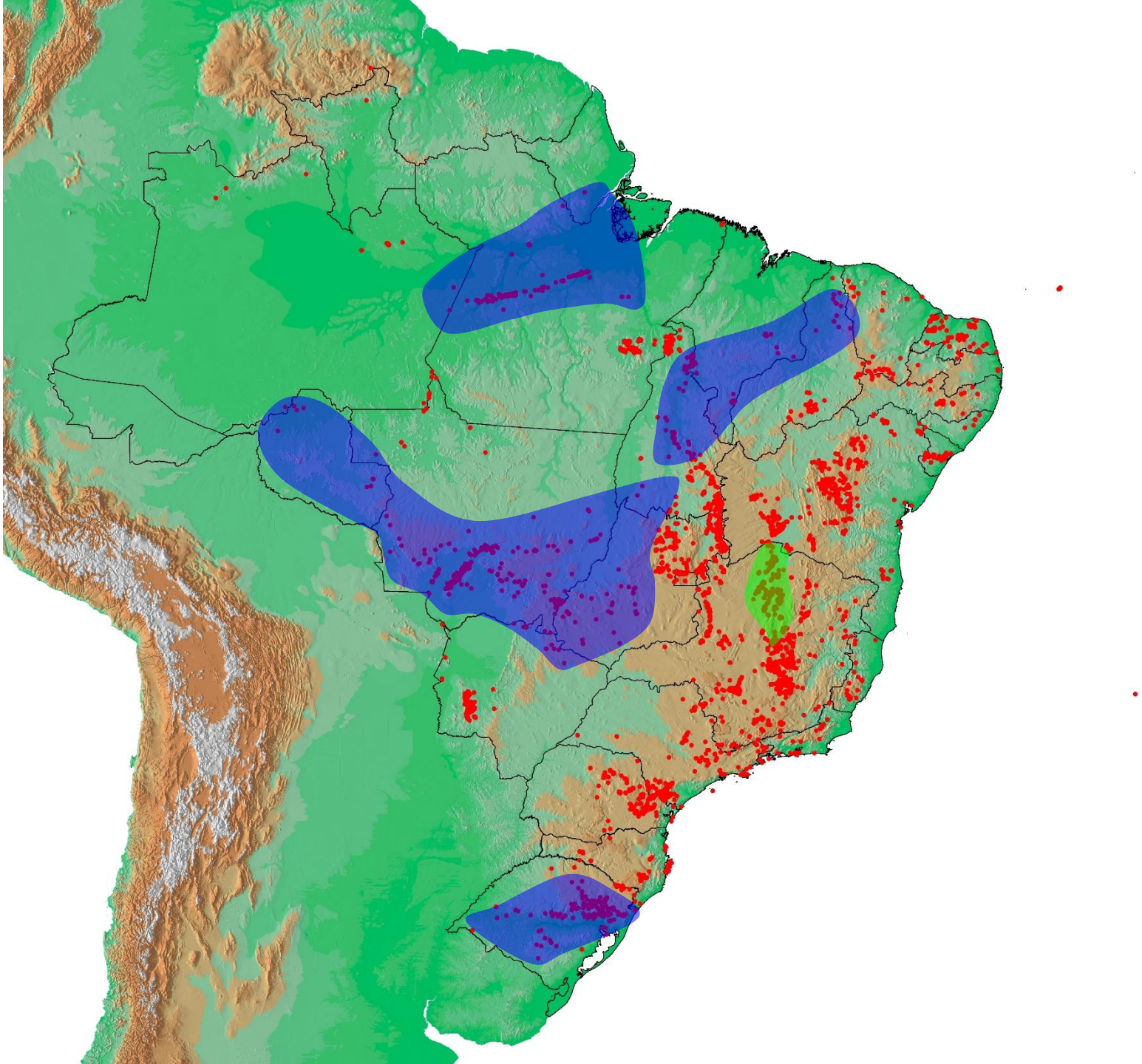

Até 2008 – 75 espécies
De 2009 em diante…
171 espécies (~70%)
Até 2008 ~ 6.000 cavernas
Atualmente ~ 22.000 cavernas

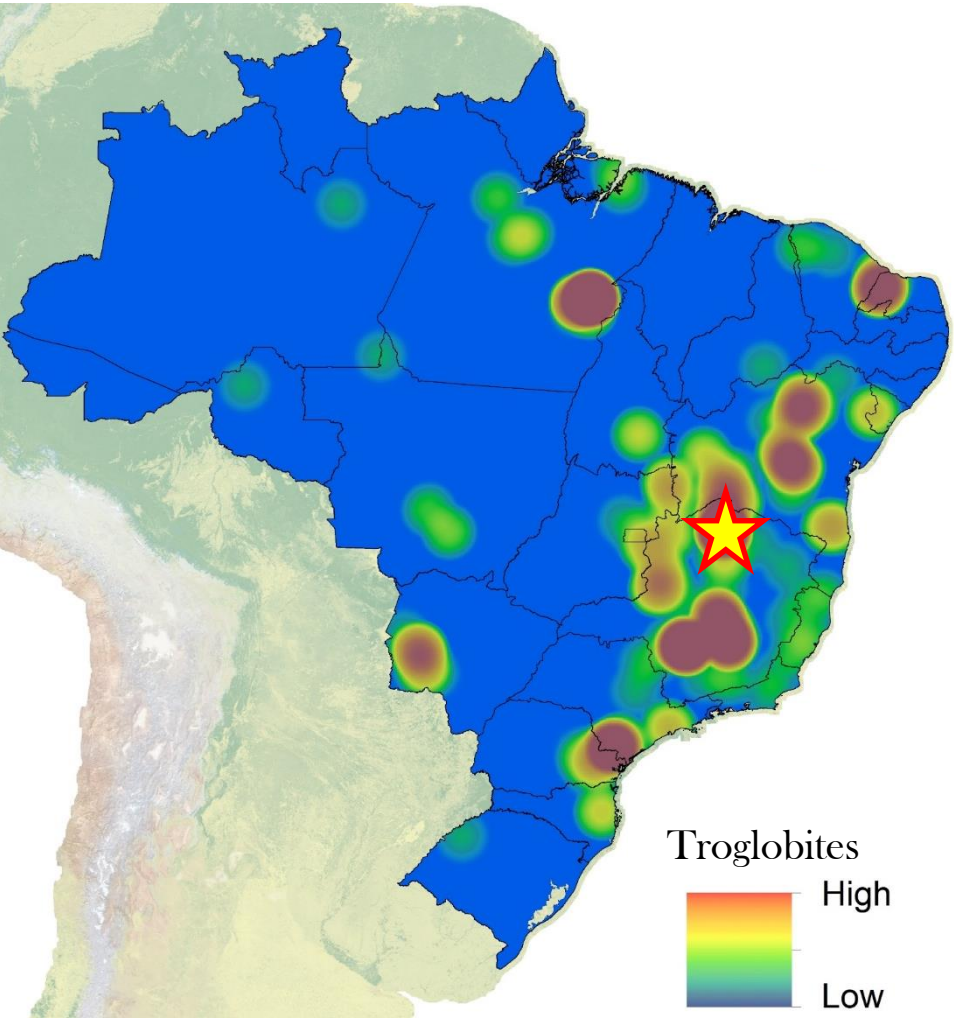

Embora existam
246 espécies descritas
Existem pelo menos **800**
espécies ainda não descritas
Atualmente ≥ **1050** espécies

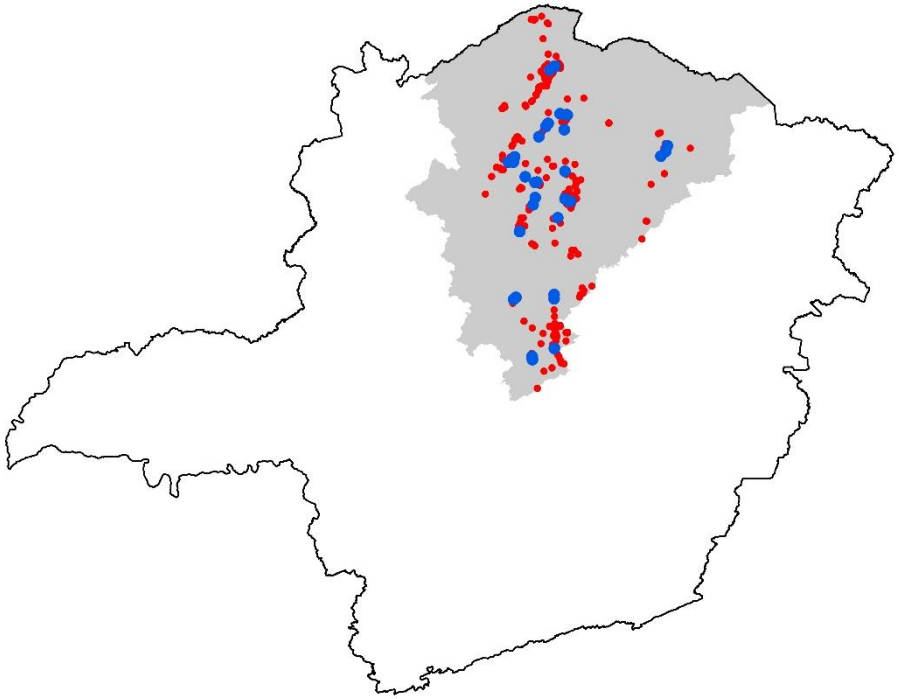

60°0'0"W
40°0'0"W
10°0'0"N
10°0'0"S
30°0'0"S
N
Troglobites
High
Low
0
1.000
2.000
Km
1:25.000.000




Troglobites
High
Low







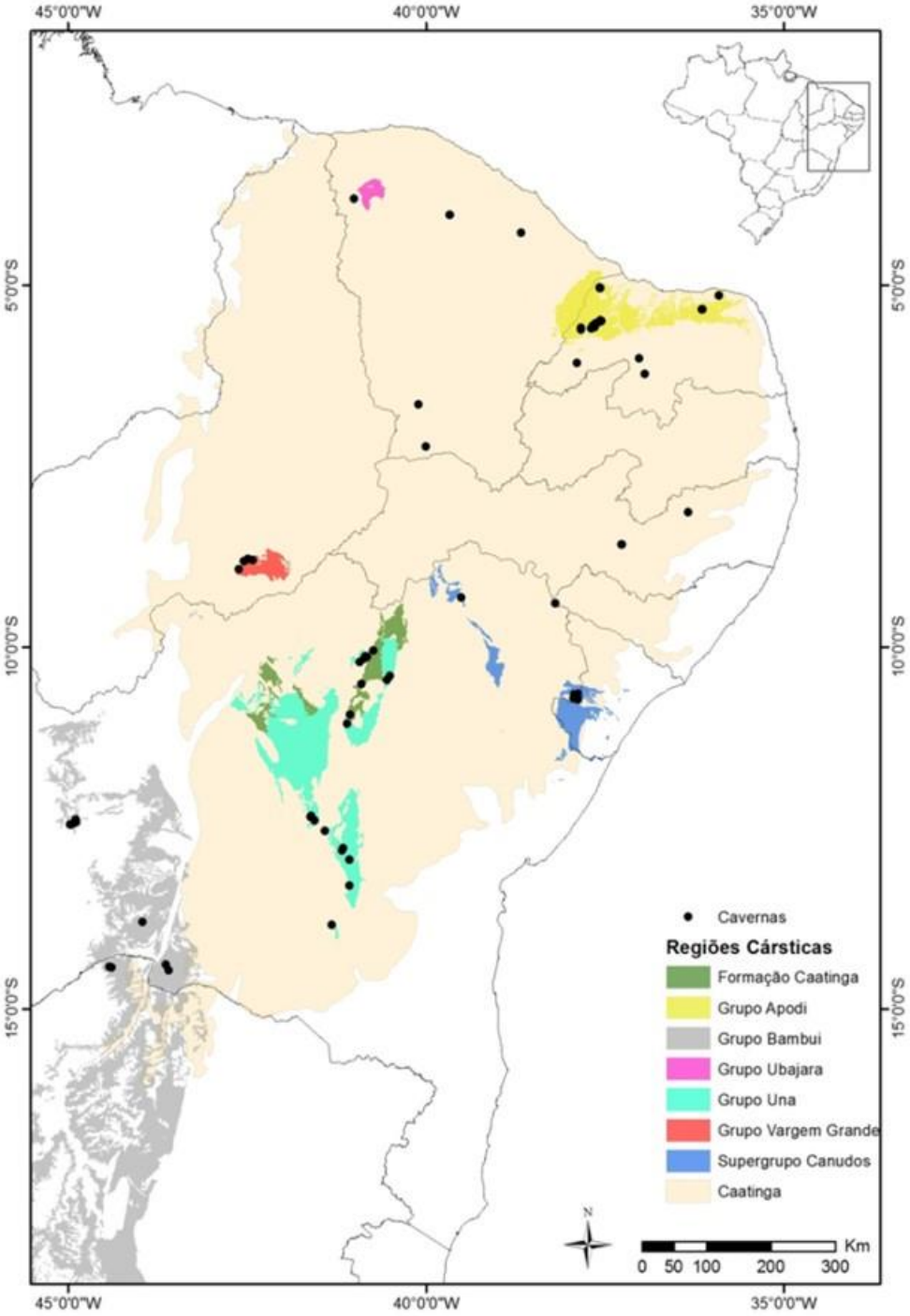
690 cavernas registradas

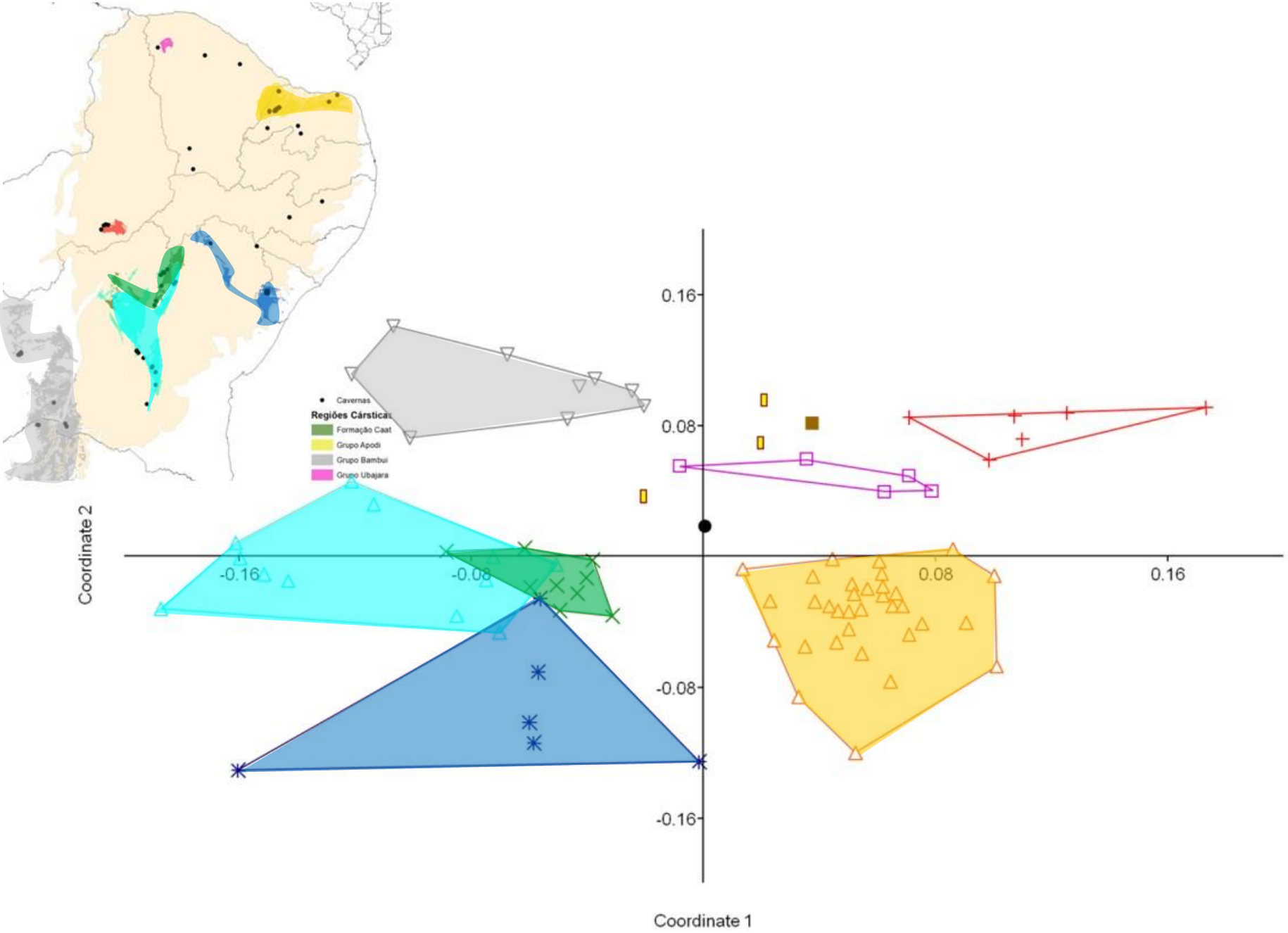
51 amostradas

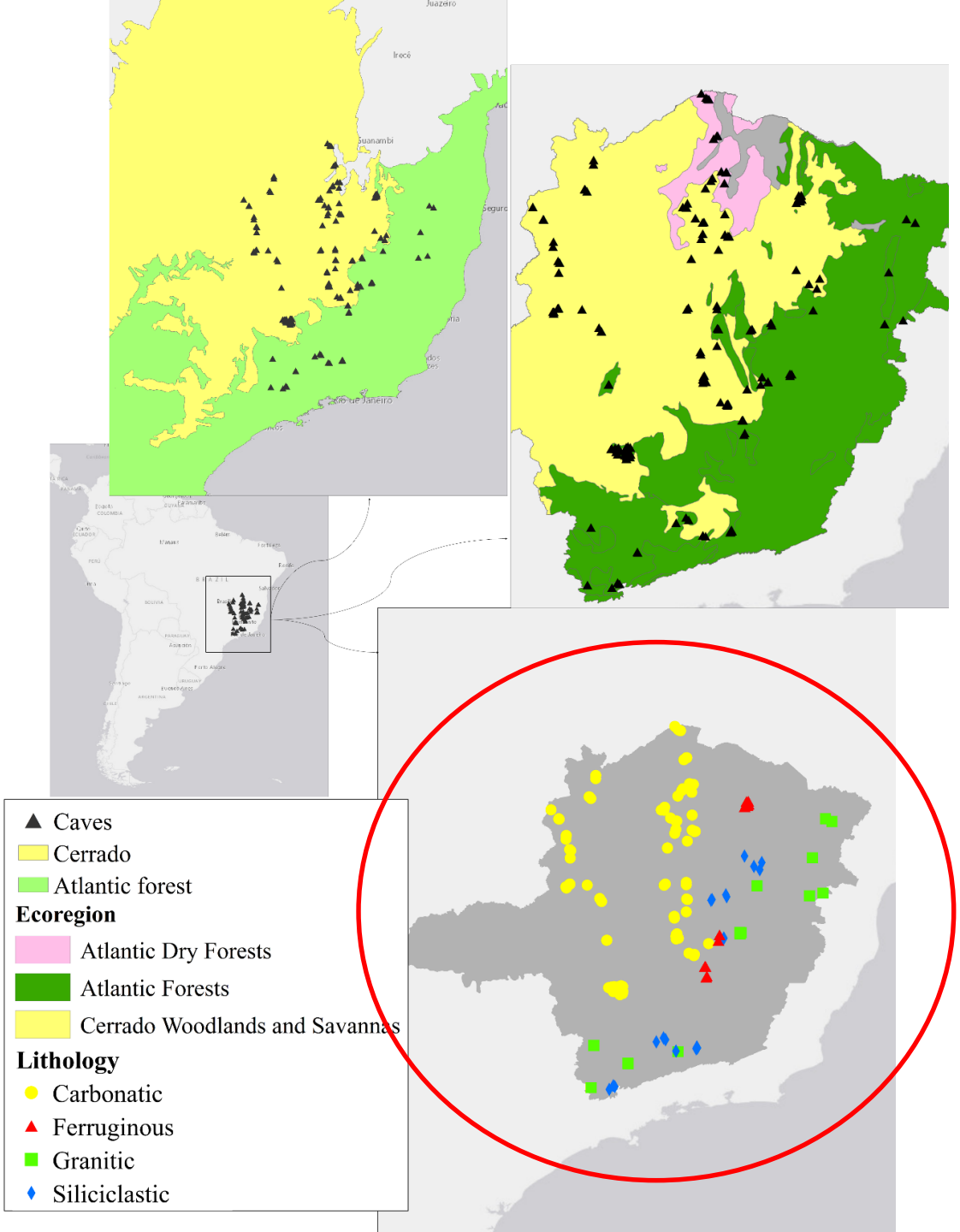
94 espécies troglóbias

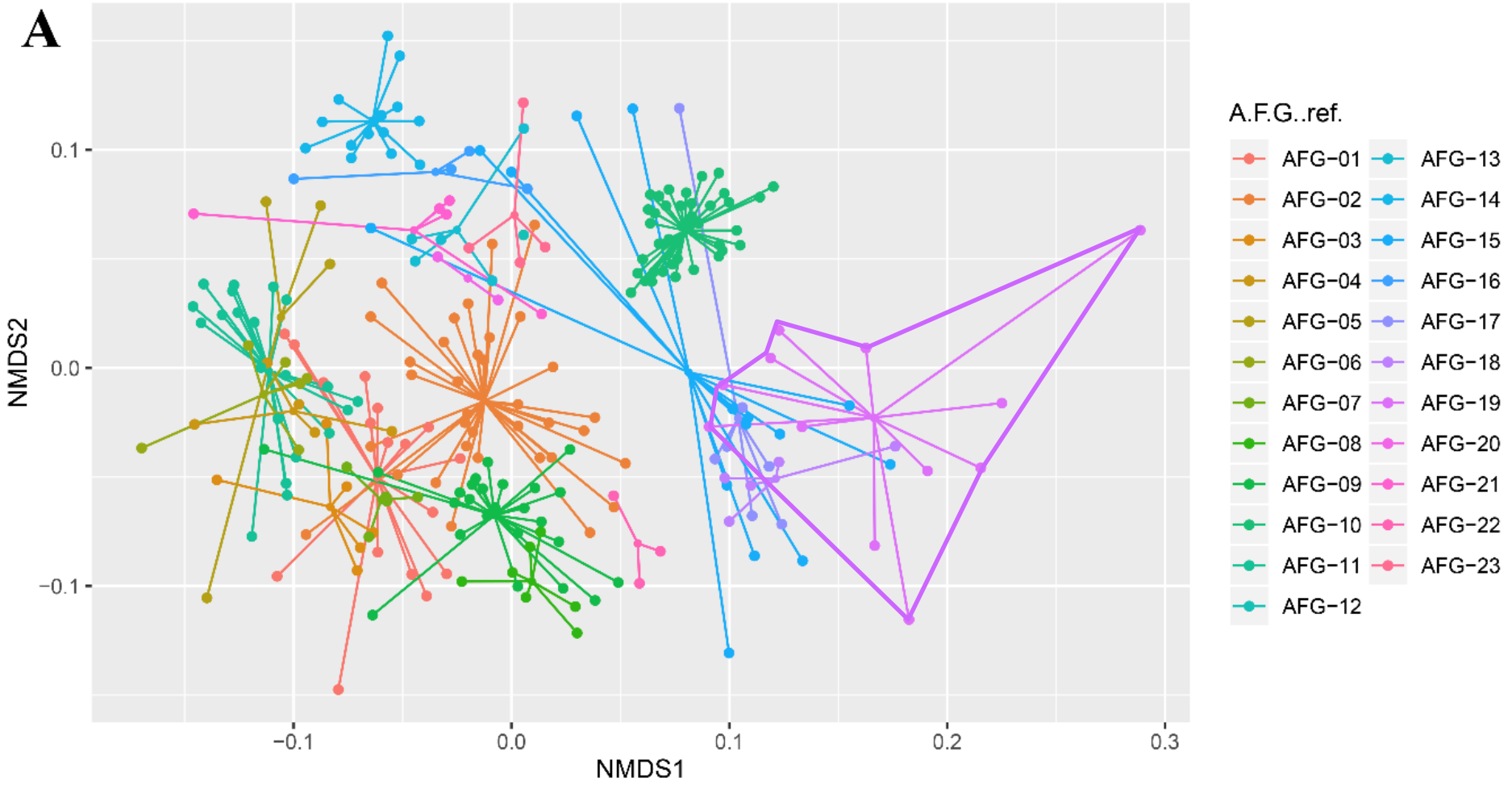
Mas, de fato, como as universidades podem contribuir para a tomada de decisões em relação à conservação das cavernas?

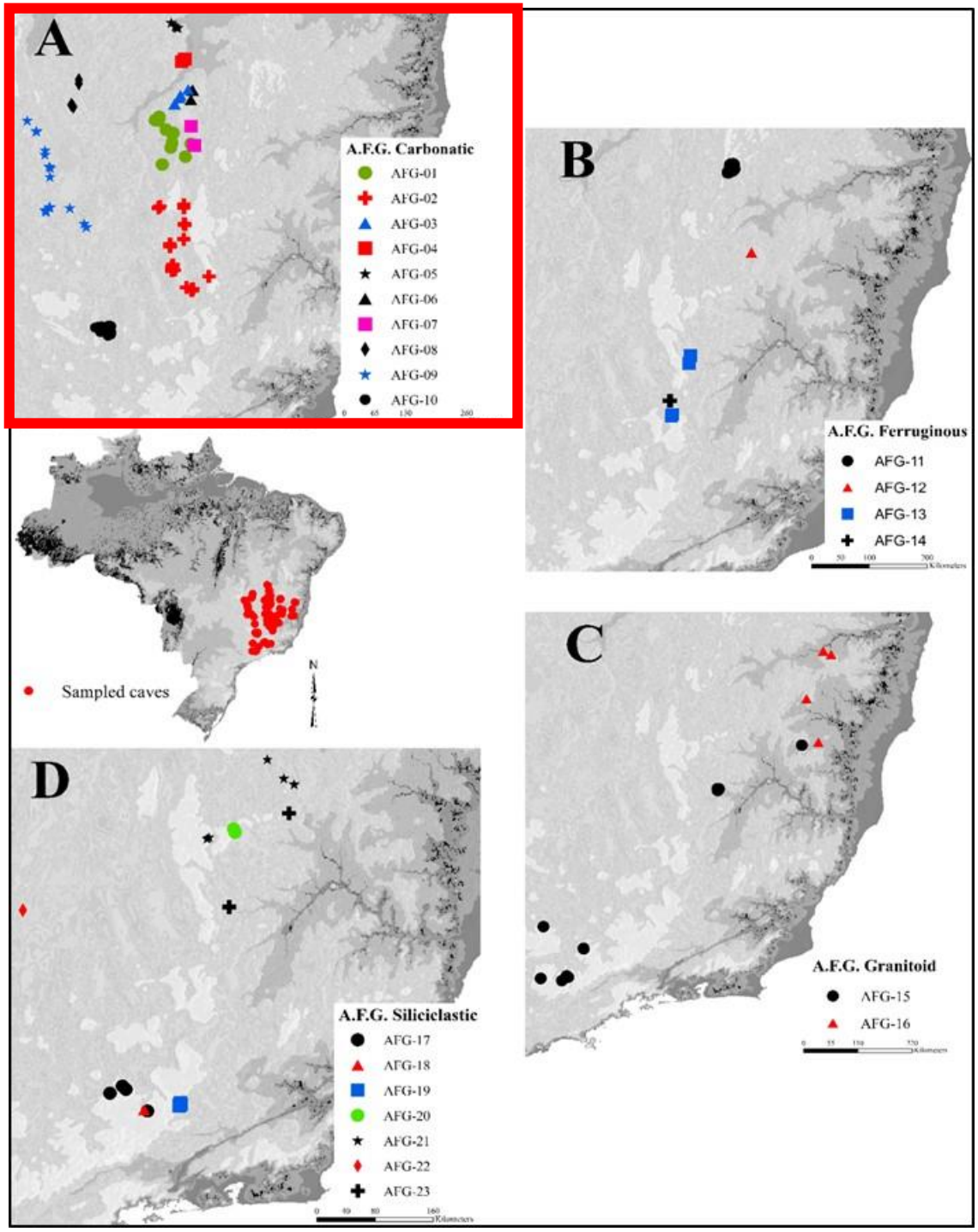
As compensações que atualmente ocorrem, de fato **compensam** as perdas?

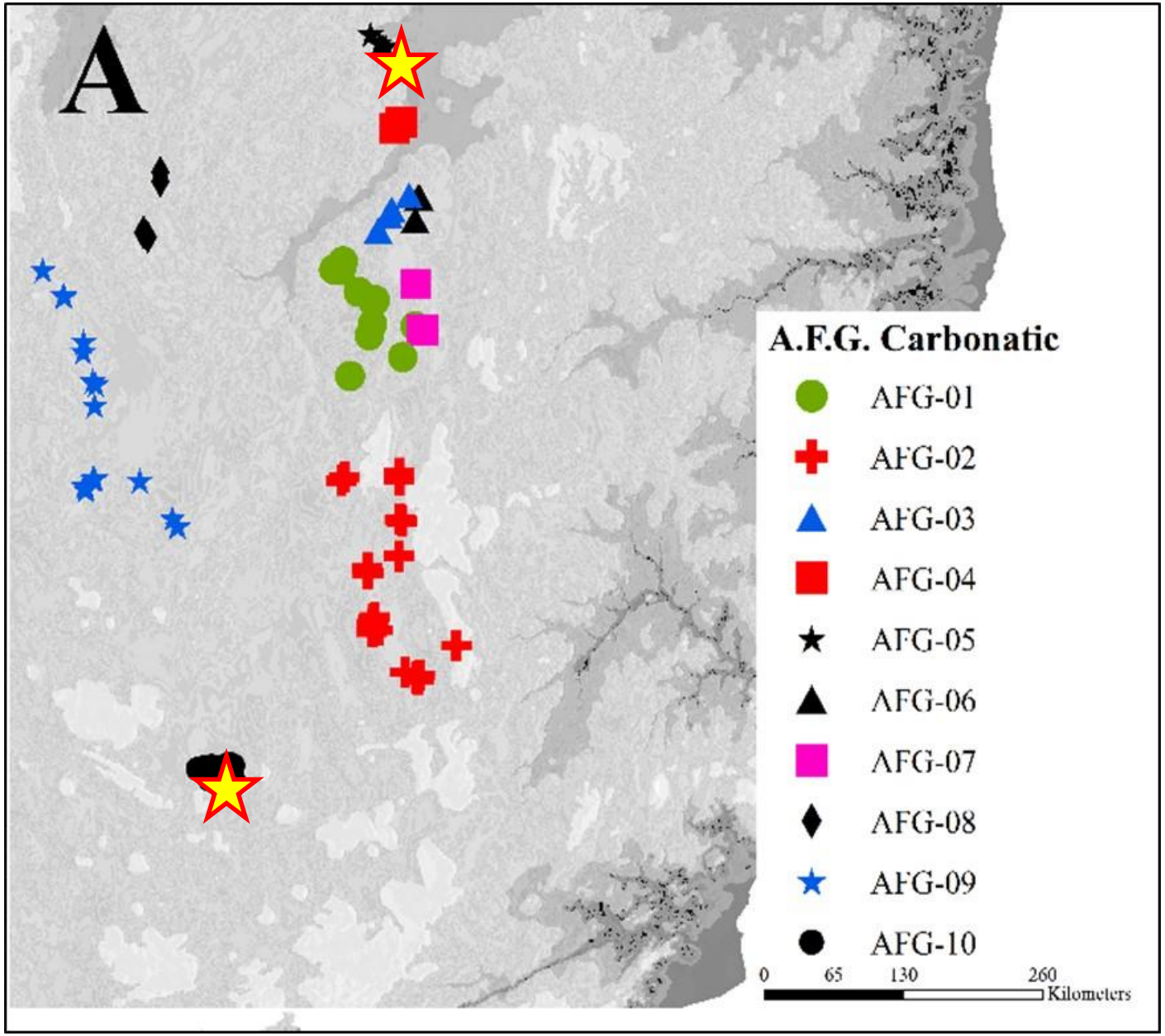

45°0'0"W
40°0'0"W
35°0'0"W
5°0'0"S
10°0'0"S
15°0'0"S
Cavernas
Regiões Cársticas
Formação Caatinga
Grupo Apodi
Grupo Bambui
Grupo Ubajara
Grupo Una
Grupo Vargem Grande
Supergrupo Canudos
Caatinga
N
Km
0 50 100 200 300


Cavernas
Regiões Cársticas
Formação Caat
Grupo Apodi
Grupo Bambuí
Grupo Ubajara
0.16
0.08
-0.08
-0.16
-0.16
-0.08
0.08
0.16
Coordinate 2
Coordinate 1

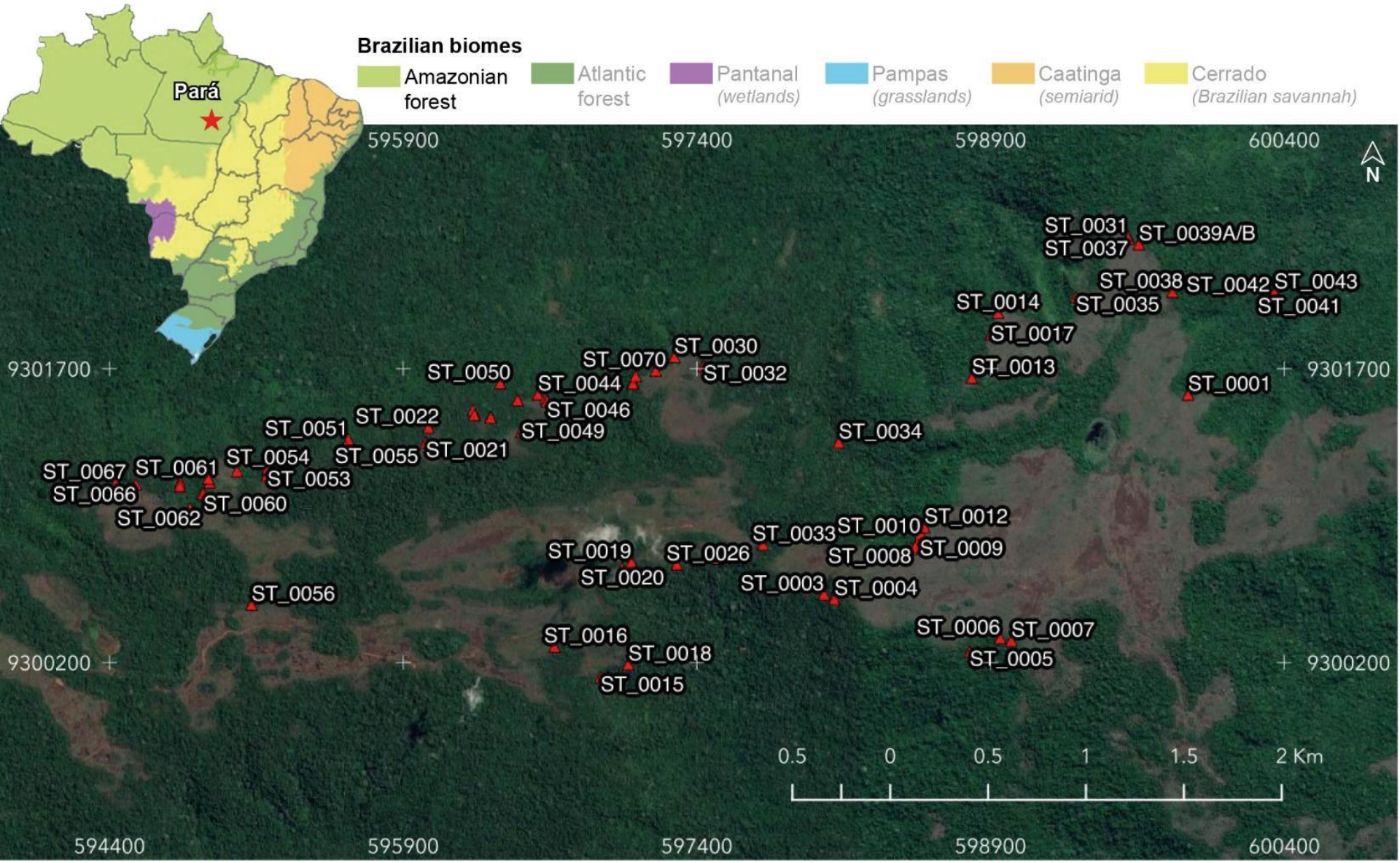

Caves
Cerrado
Atlantic forest
Ecoregion
Atlantic Dry Forests
Atlantic Forests
Cerrado Woodlands and Savannas
Lithology
Carbonatic
Ferruginous
Granitic
Siliciclastic

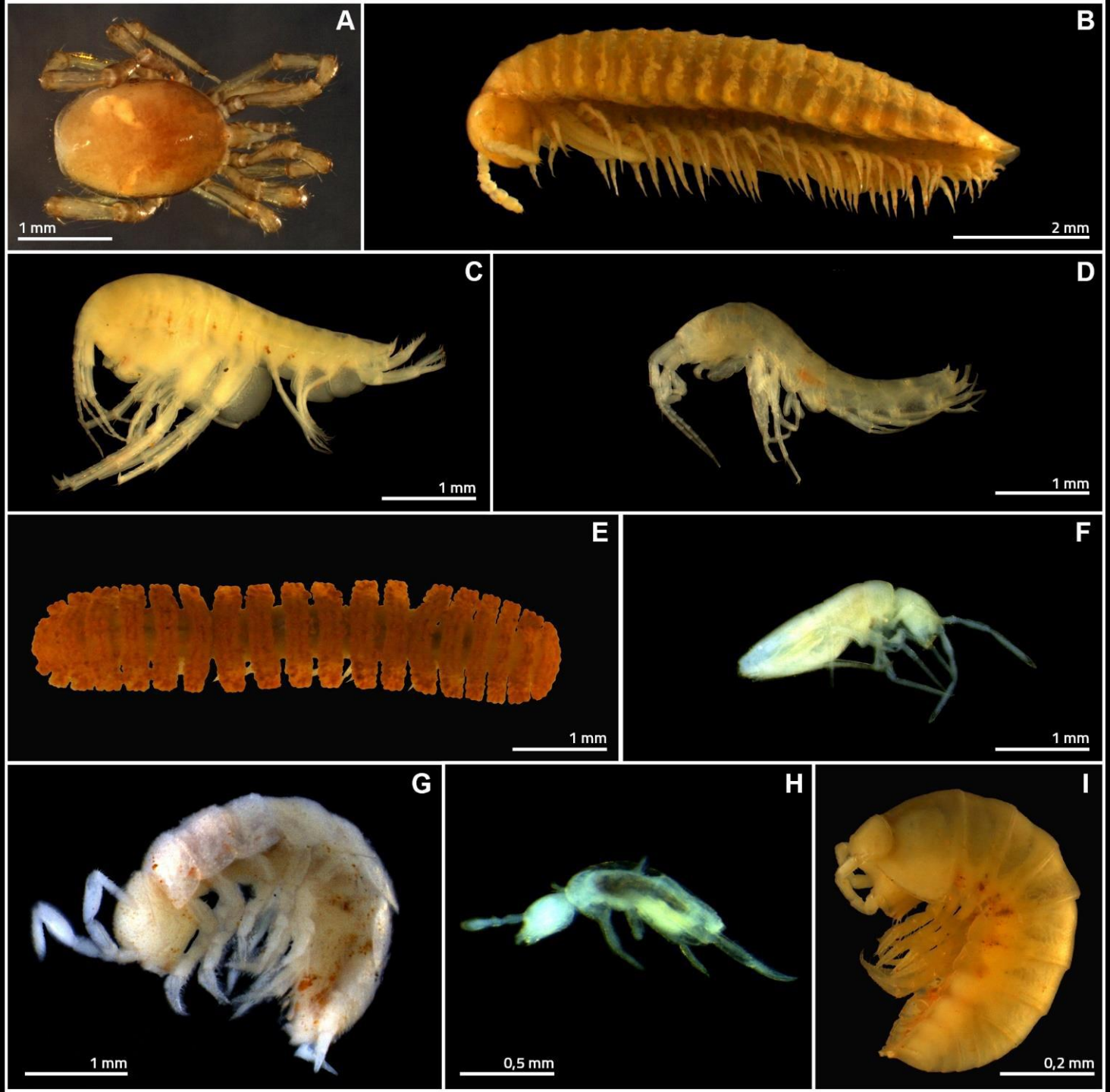

A
NMDS2
NMDS1
0.1
0.0
−0.1
−0.1
0.0
0.1
0.2
0.3
A.F.G..ref.
AFG−01
AFG−02
AFG−03
AFG−04
AFG−05
AFG−06
AFG−07
AFG−08
AFG−09
AFG−10
AFG−11
AFG−12
AFG−13
AFG−14
AFG−15
AFG−16
AFG−17
AFG−18
AFG−19
AFG−20
AFG−21
AFG−22
AFG−23


A
A.F.G. Carbonatic
AFG-01
AFG-02
AFG-03
AFG-04
AFG-05
AFG-06
AFG-07
AFG-08
AFG-09
AFG-10
B
A.F.G. Ferruginous
AFG-11
AFG-12
AFG-13
AFG-14
Sampled caves
N
C
A.F.G. Granitoid
AFG-15
AFG-16
D
A.F.G. Siliciclastic
AFG-17
AFG-18
AFG-19
AFG-20
AFG-21
AFG-22
AFG-23


A
A.F.G. Carbonatic
AFG-01
AFG-02
AFG-03
AFG-04
AFG-05
AFG-06
AFG-07
AFG-08
AFG-09
AFG-10
0
65
130
260
Kilometers

Como pode ser definida
a **área de influência** de uma caverna?

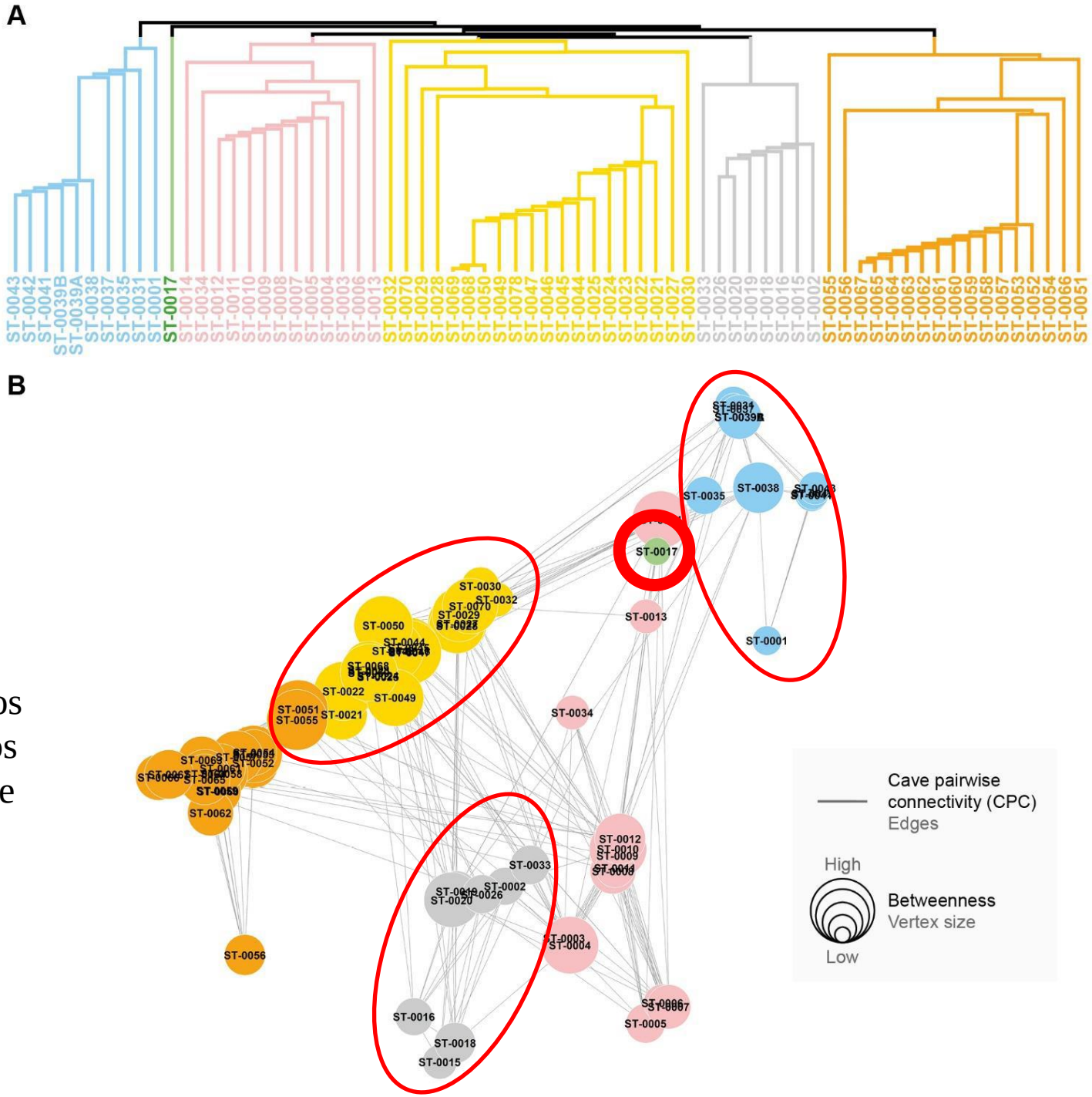

Brazilian biomes
Amazonian forest
Atlantic forest
Pantanal (wetlands)
Pampas (grasslands)
Caatinga (semiarid)
Cerrado (Brazilian savannah)
Pará
595900
597400
598900
600400
N
9301700
9300200
ST_0031
ST_0039A/B
ST_0037
ST_0038
ST_0042
ST_0043
ST_0014
ST_0035
ST_0041
ST_0017
ST_0030
ST_0070
ST_0032
ST_0013
ST_0001
ST_0050
ST_0044
ST_0046
ST_0022
ST_0049
ST_0051
ST_0034
ST_0021
ST_0055
ST_0054
ST_0067
ST_0061
ST_0053
ST_0066
ST_0060
ST_0062
ST_0012
ST_0010
ST_0033
ST_0019
ST_0026
ST_0009
ST_0008
ST_0020
ST_0003
ST_0004
ST_0056
ST_0006
ST_0007
ST_0016
ST_0018
ST_0005
ST_0015
0.5
0
0.5
1
1.5
2 Km
594400
595900
597400
598900
600400

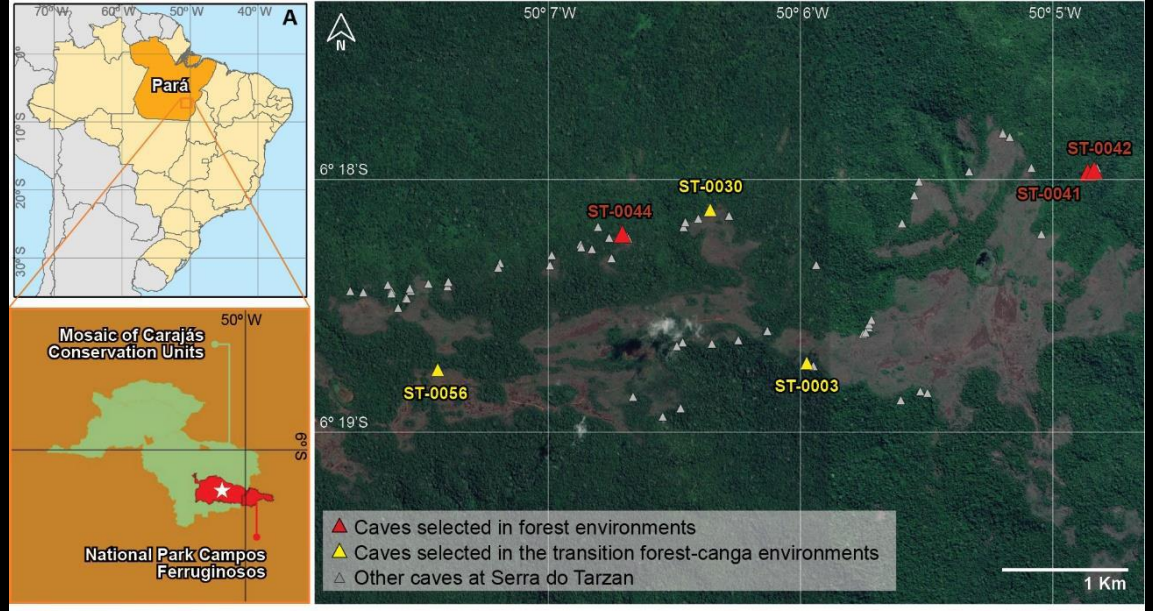

A
1 mm
B
2 mm
C
1 mm
D
1 mm
E
1 mm
F
1 mm
G
1 mm
H
0,5 mm
I
0,2 mm


A
Species composition
Spatial autocorrelation metrics
CPC: 0.279
B
Species composition
Piecewise regression metrics
CPC: 0.250
C
Phylogenetic distance
Spatial autocorrelation metrics
CPC: 0.157
D
Phylogenetic distance
Piecewise regression metrics
CPC: 0.170
Cave pairwise connectivity (CPC)
Edges
1
2
3
4
5
Number of troglobites
Vertex size

Os modelos indicaram que as características da **paisagem** e do **habitat** são mais importantes do que a **distância geográfica** na determinação de padrões de **similaridade** entre cavernas.

Mesmo em aglomerados densamente interligados existem cavernas que se destacam por abrigar uma **fauna exclusiva** e/ou por apresentar **habitats específicos**.

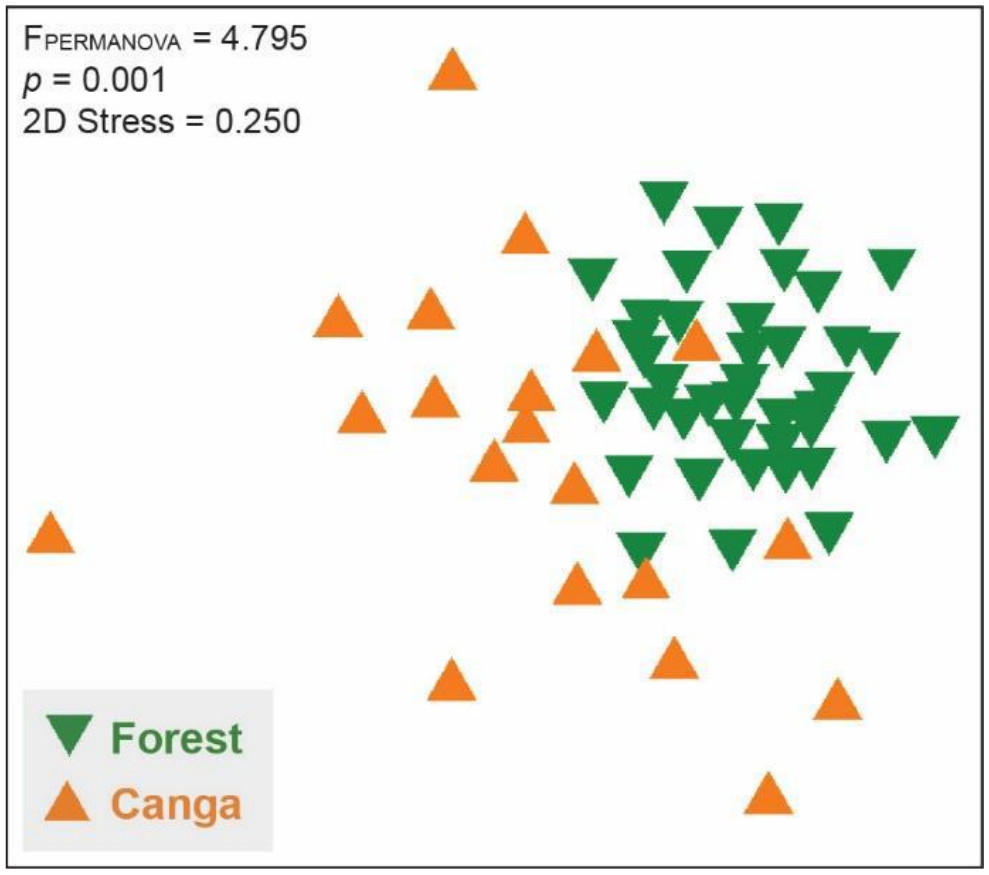


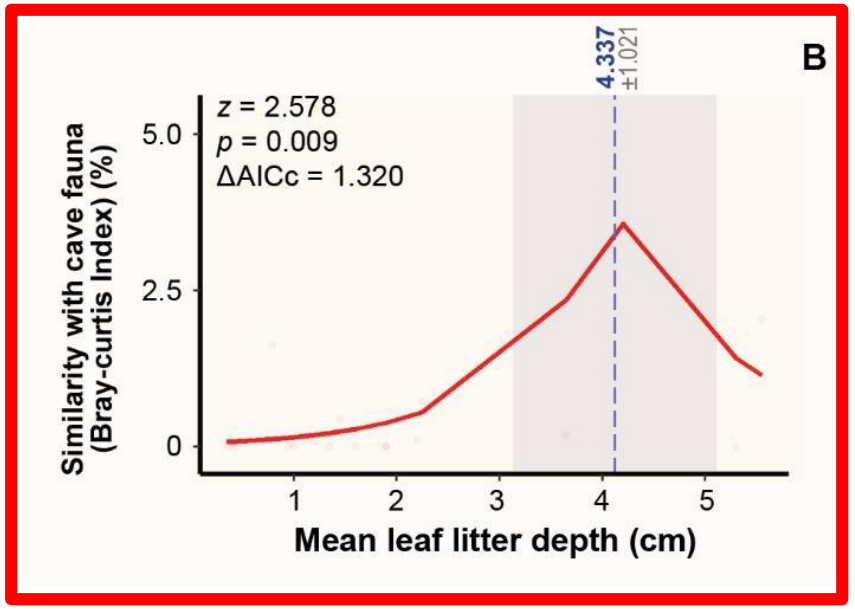

A
70° W
60° W
50° W
40° W
Pará
10° S
20° S
30° S
50° W
Mosaic of Carajás Conservation Units
6° S
National Park Campos Ferruginosos
N
50° 7'W
50° 6'W
50° 5'W
6° 18'S
6° 19'S
ST-0042
ST-0041
ST-0030
ST-0044
ST-0056
ST-0003
Caves selected in forest environments
Caves selected in the transition forest-canga environments
Other caves at Serra do Tarzan
1 Km

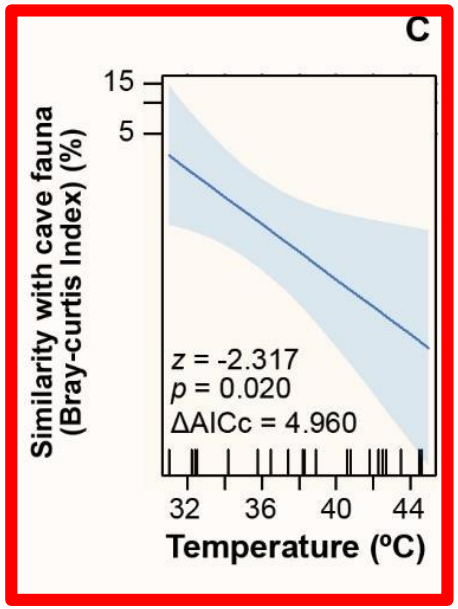

C
100 m
80 m
60 m
40 m
20 m
2 m
above
20 m
40 m
60 m
80 m
100 m
below

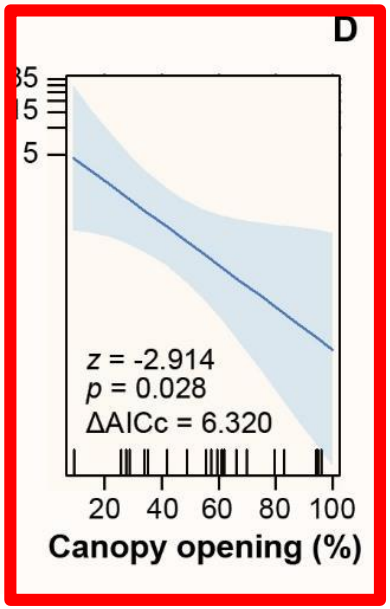

D

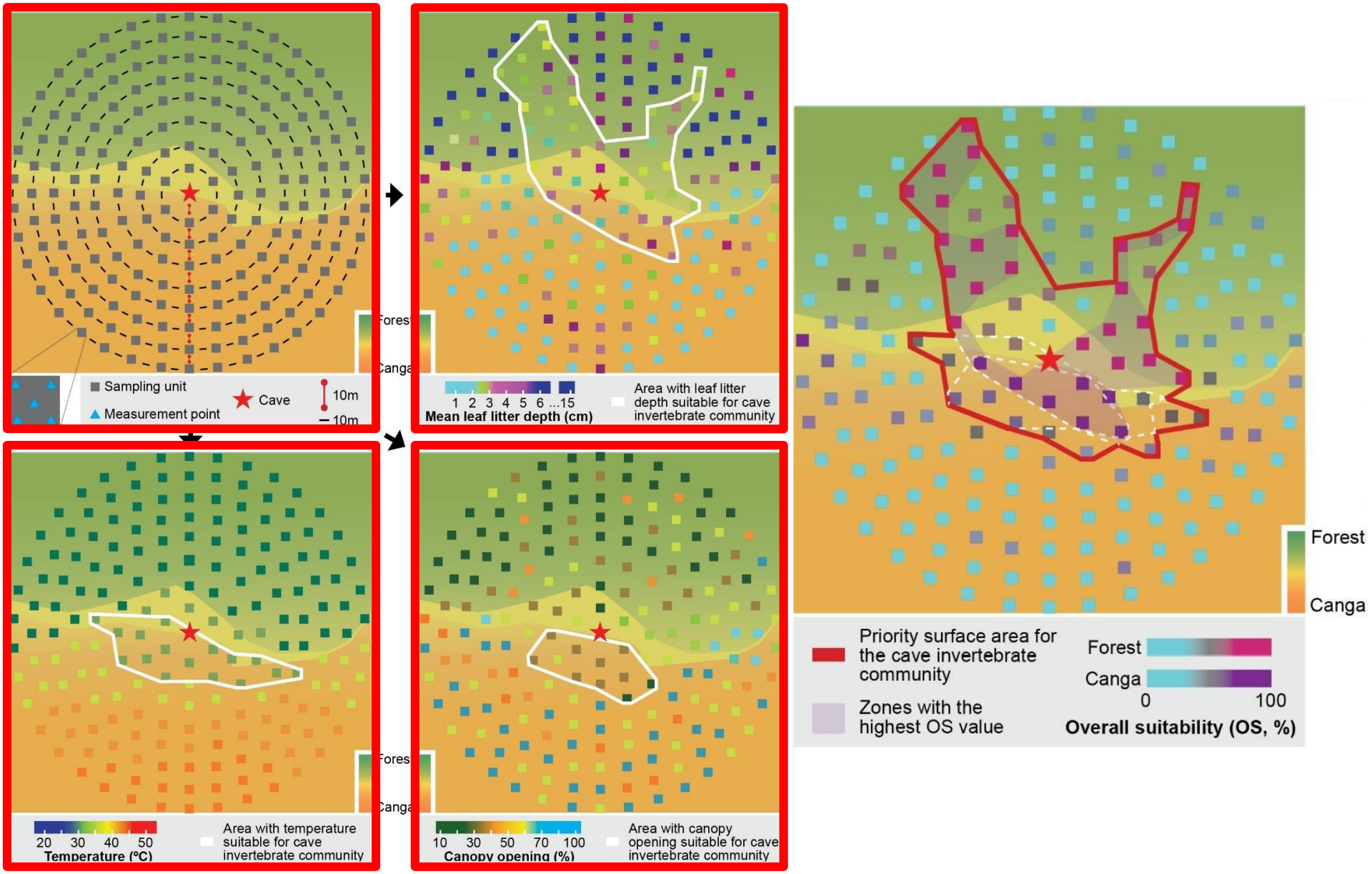

E


FPERMANOVA = 4.795
p = 0.001
2D Stress = 0.250
Forest
Canga

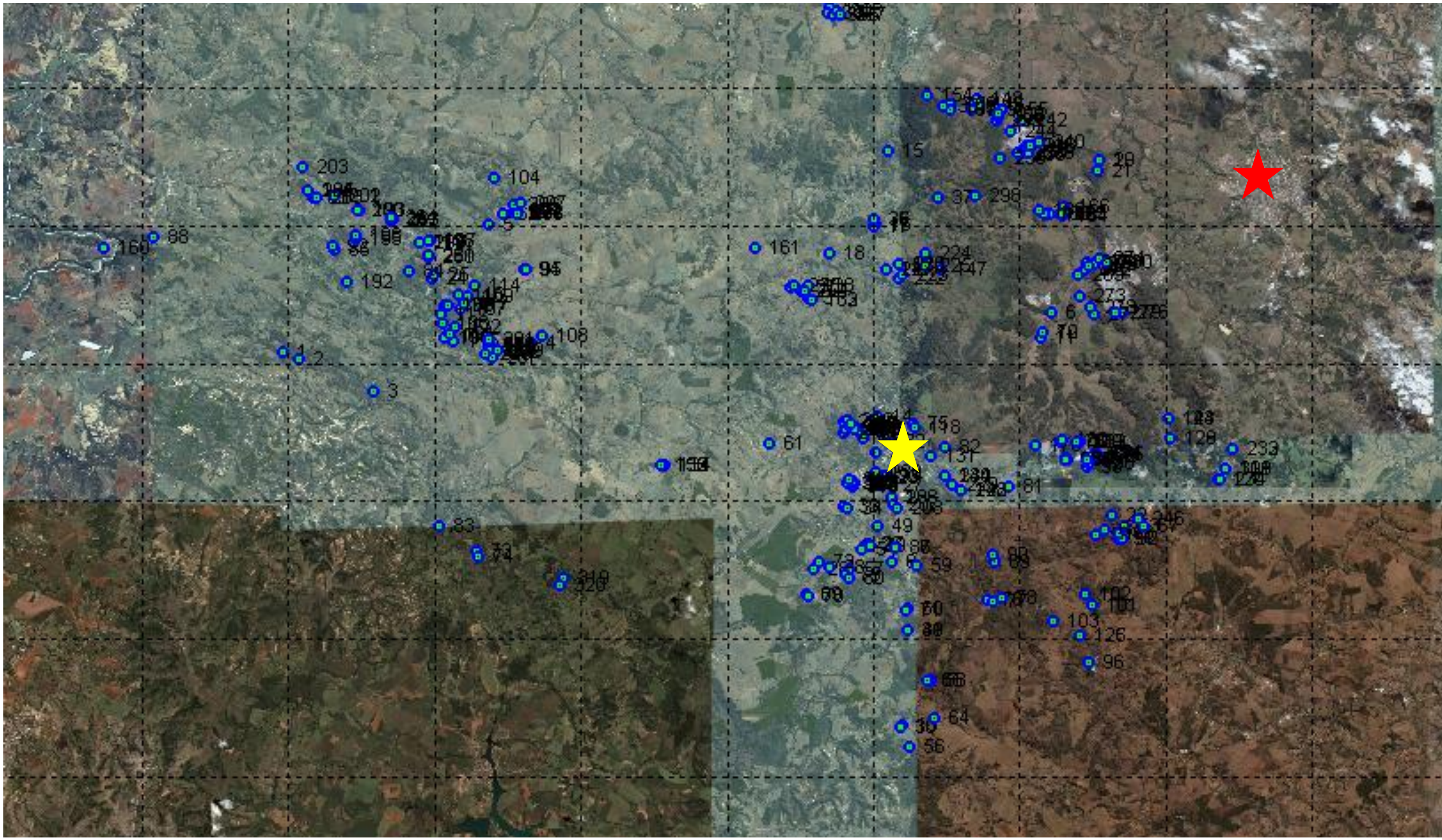

B
4.337
±1.021
z = 2.578
p = 0.009
ΔAICc = 1.320
Similarity with cave fauna (Bray-curtis Index) (%)
5.0
2.5
0
1
2
3
4
5
Mean leaf litter depth (cm)


C
Similarity with cave fauna (Bray-curtis Index) (%)
15
5
z = -2.317
p = 0.020
ΔAICc = 4.960
32
36
40
44
Temperature (ºC)

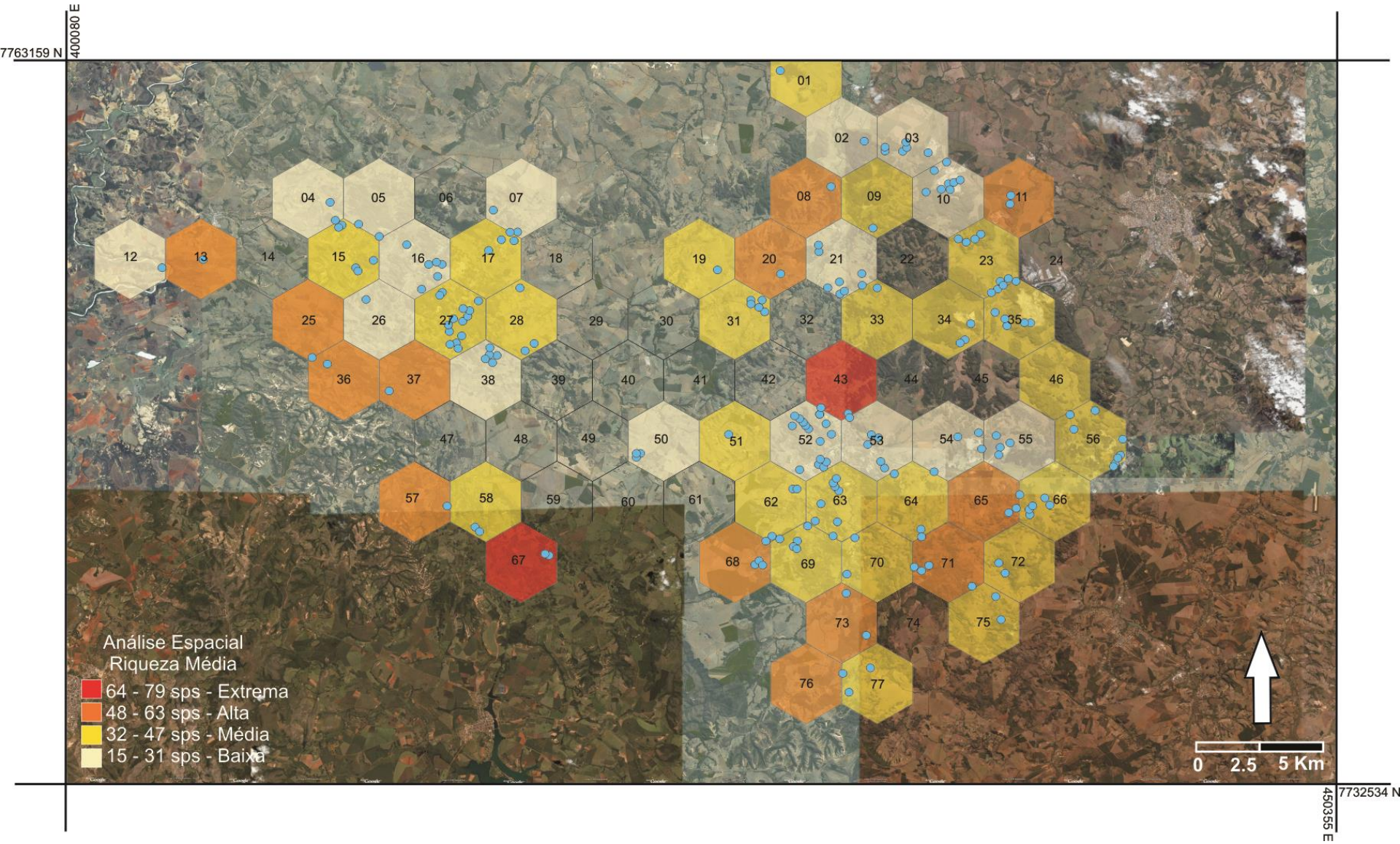

D
15
5
z = -2.914
p = 0.028
ΔAICc = 6.320
20
40
60
80
100
Canopy opening (%)


Sampling unit
Measurement point
Cave
10m
10m
Forest
Canga
1 2 3 4 5 6 ...15
Mean leaf litter depth (cm)
Area with leaf litter depth suitable for cave invertebrate community
20 30 40 50
Temperature (°C)
Area with temperature suitable for cave invertebrate community
10 30 50 70 100
Canopy opening (%)
Area with canopy opening suitable for cave invertebrate community
Priority surface area for the cave invertebrate community
Zones with the highest OS value
Forest
Canga
0
100
Overall suitability (OS, %)

Como definir prioridades de conservação?



203
104
160
88
192
1
2
3
108
161
18
15
37
298
273
61
131
81
233
128
83
49
59
103
126
96
64
56


7763159 N
400080 E
7732534 N
450355 E
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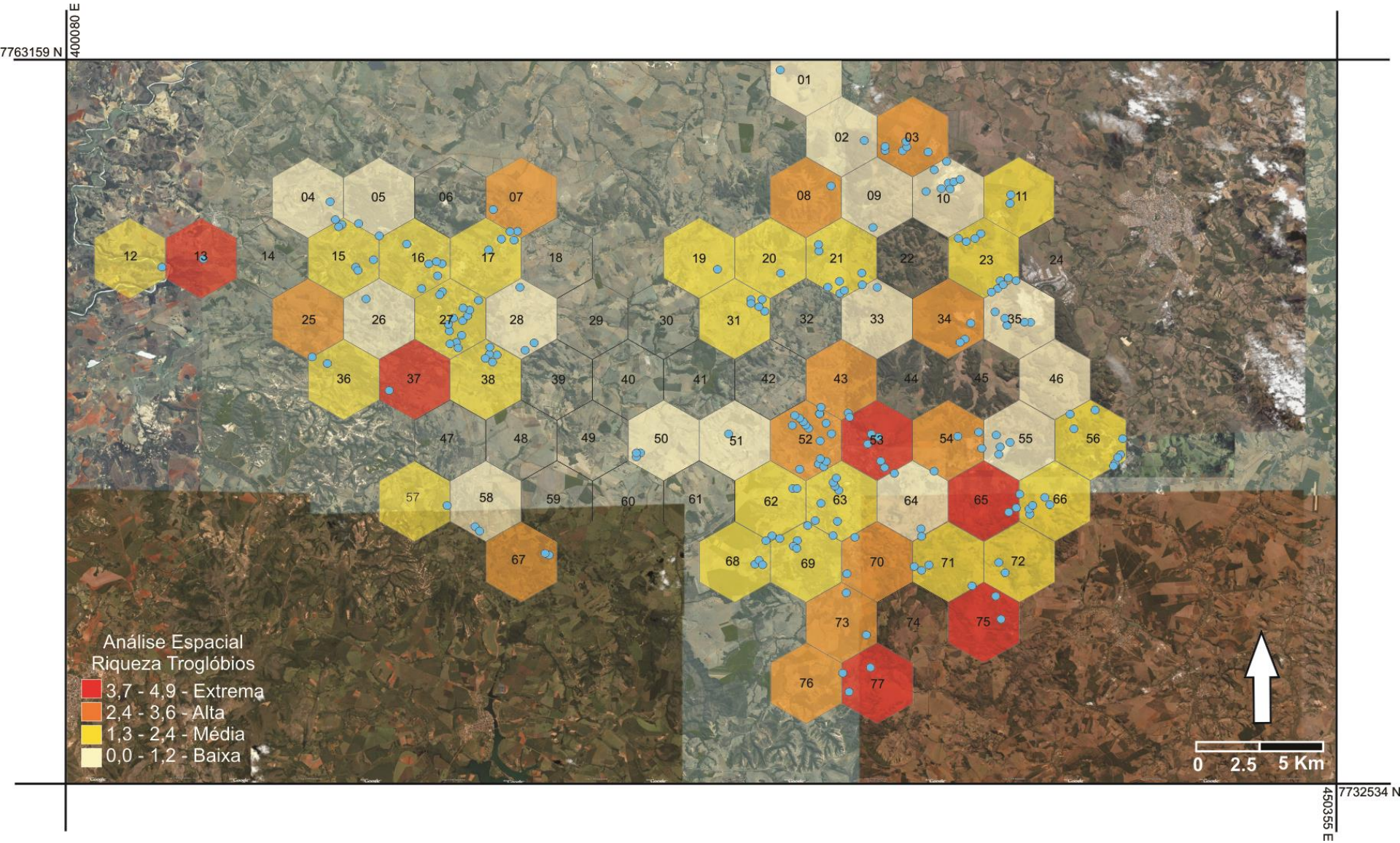
77
Análise Espacial
Riqueza Média
64 - 79 sps - Extrema
48 - 63 sps - Alta
32 - 47 sps - Média
15 - 31 sps - Baixa
0 2.5 5 Km


400080 E
7763159 N
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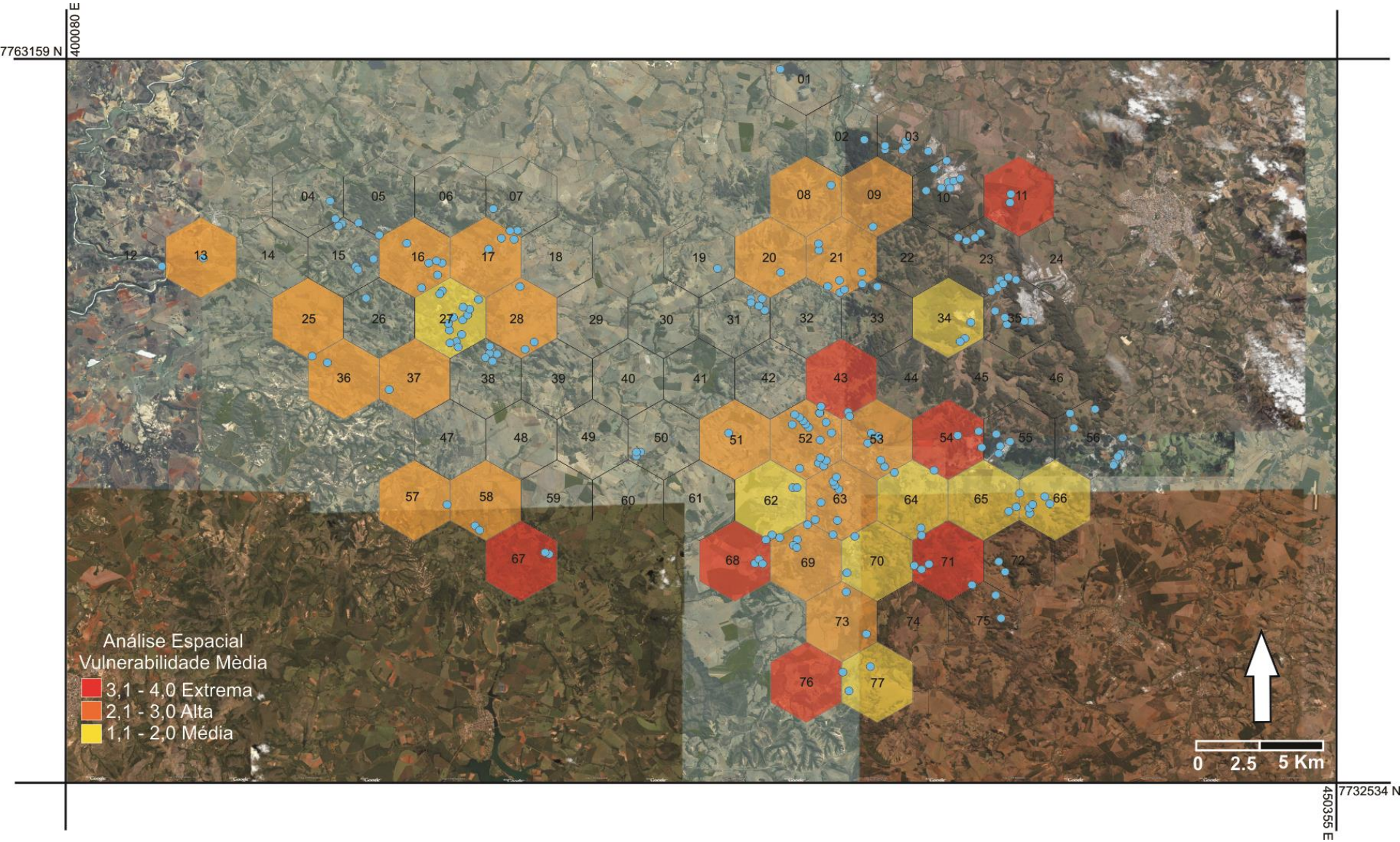
77
Análise Espacial
Riqueza Troglóbios
3,7 - 4,9 - Extrema
2,4 - 3,6 - Alta
1,3 - 2,4 - Média
0,0 - 1,2 - Baixa
0 2.5 5 Km
7732534 N
450355 E


7763159 N
400080 E
7732534 N
450355 E
01
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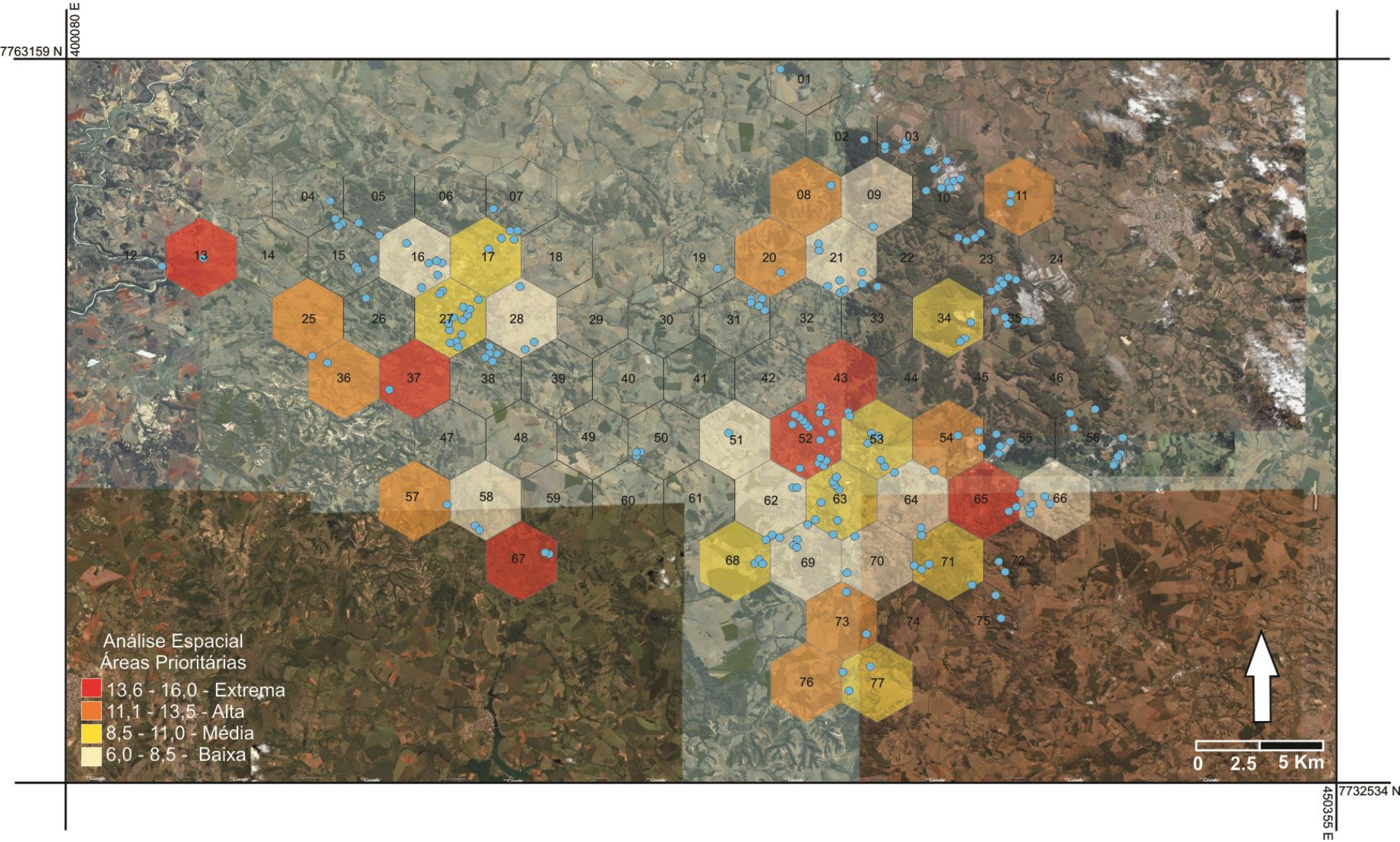
77
Análise Espacial
Vulnerabilidade Mèdia
3,1 - 4,0 Extrema
2,1 - 3,0 Alta
1,1 - 2,0 Média
0
2.5
5 Km


7763159 N
400080 E
7732534 N
450355 E
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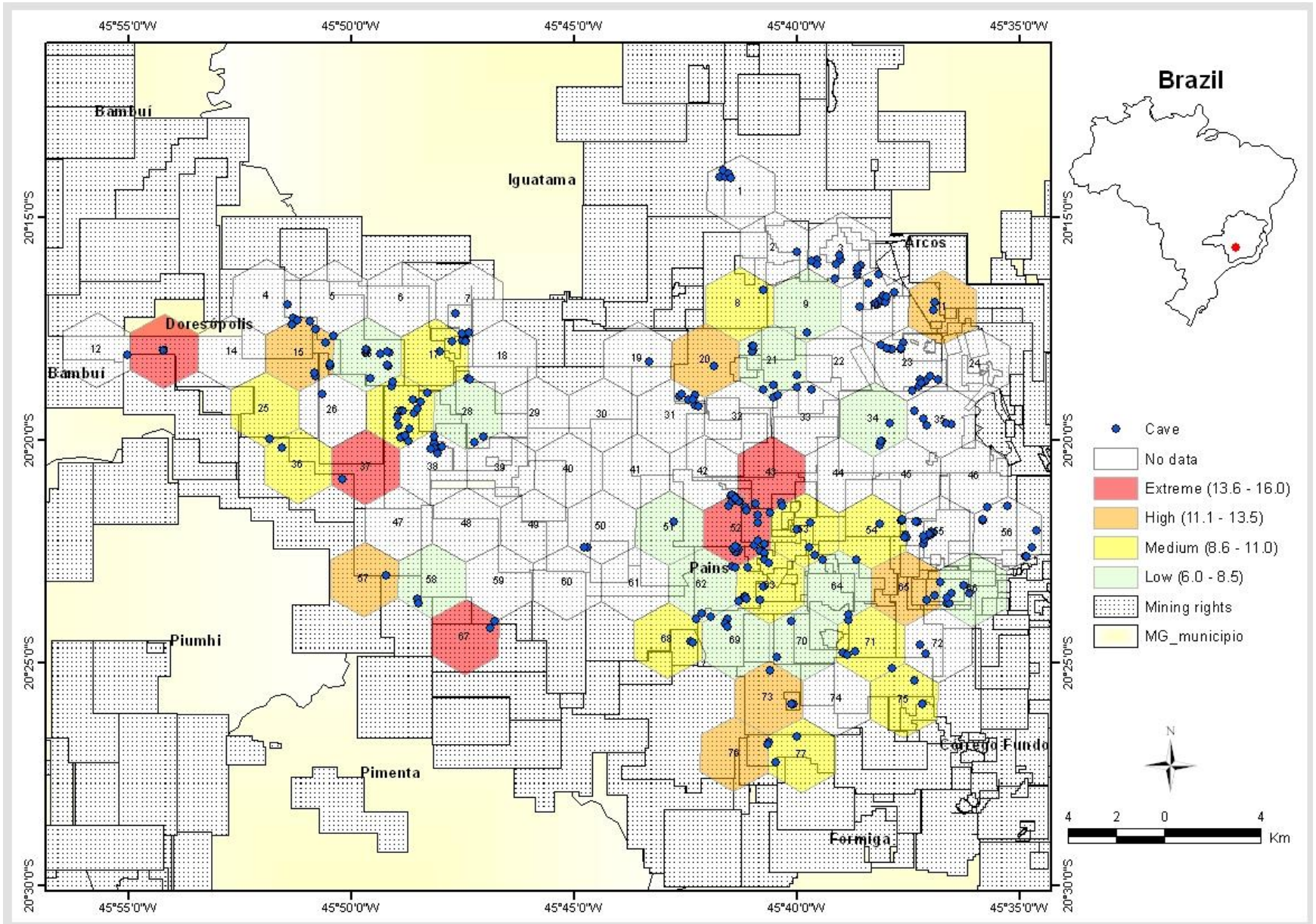
Análise Espacial
Áreas Prioritárias
13,6 - 16,0 - Extrema
11,1 - 13,5 - Alta
8,5 - 11,0 - Média
6,0 - 8,5 - Baixa
0 2.5 5 Km


45°55'0"W
45°50'0"W
45°45'0"W
45°40'0"W
45°35'0"W
20°15'0"S
20°20'0"S
20°25'0"S
20°30'0"S
Bambuí
Iguatama
Arcos
Doresópolis
Bambuí
Pains
Piumhi
Pimenta
Córrego Fundo
Formiga
Brazil
Cave
No data
Extreme (13.6 - 16.0)
High (11.1 - 13.5)
Medium (8.6 - 11.0)
Low (6.0 - 8.5)
Mining rights
MG_municipio
N
4 2 0 4
Km

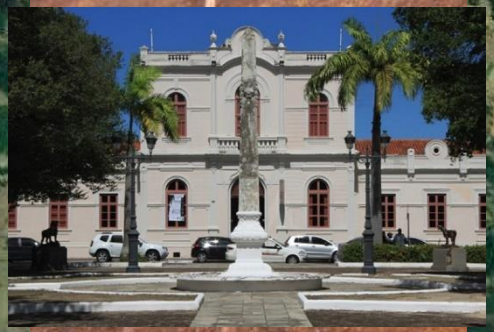
Definição de relevância

Troglóbios:

Raros

Relictos

Endêmicos



E agora? Como resolver este potencial problema?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Mas como foi possível descrever tantas espécies em tão pouco tempo?

Por causa de **EDITAIS** abertos
por agências de fomento
visando a descrição de espécies cavernícolas!

Espécies descritas pelos pesquisadores do CEBS e colaboradores

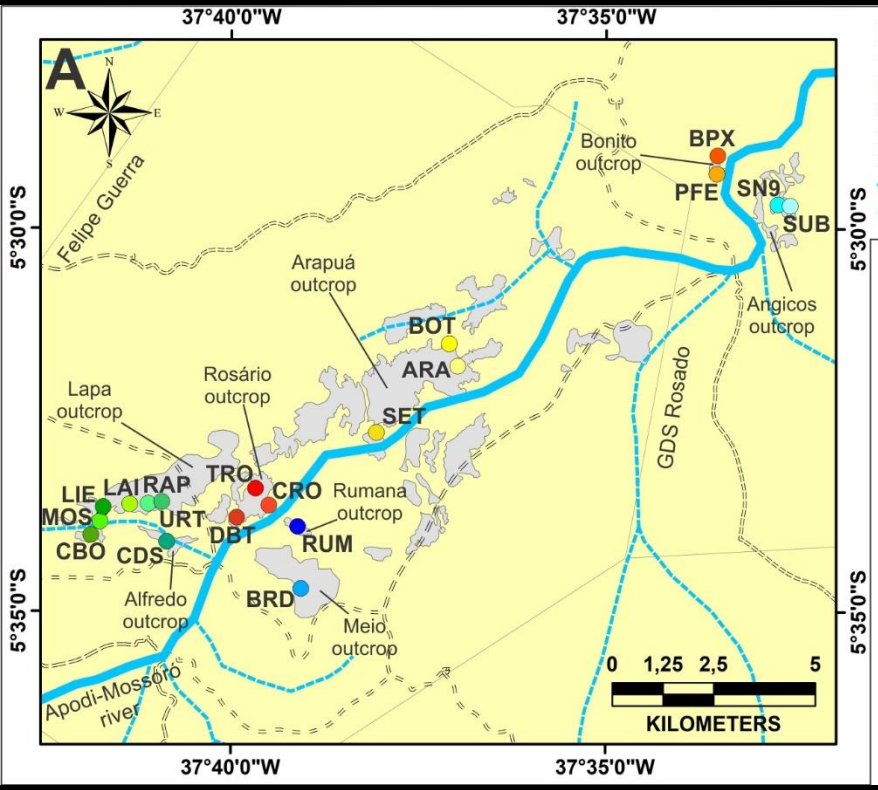
144 Espécies (83 troglóbias)
(1/3 das espécies troglóbias descritas para o Brasil)

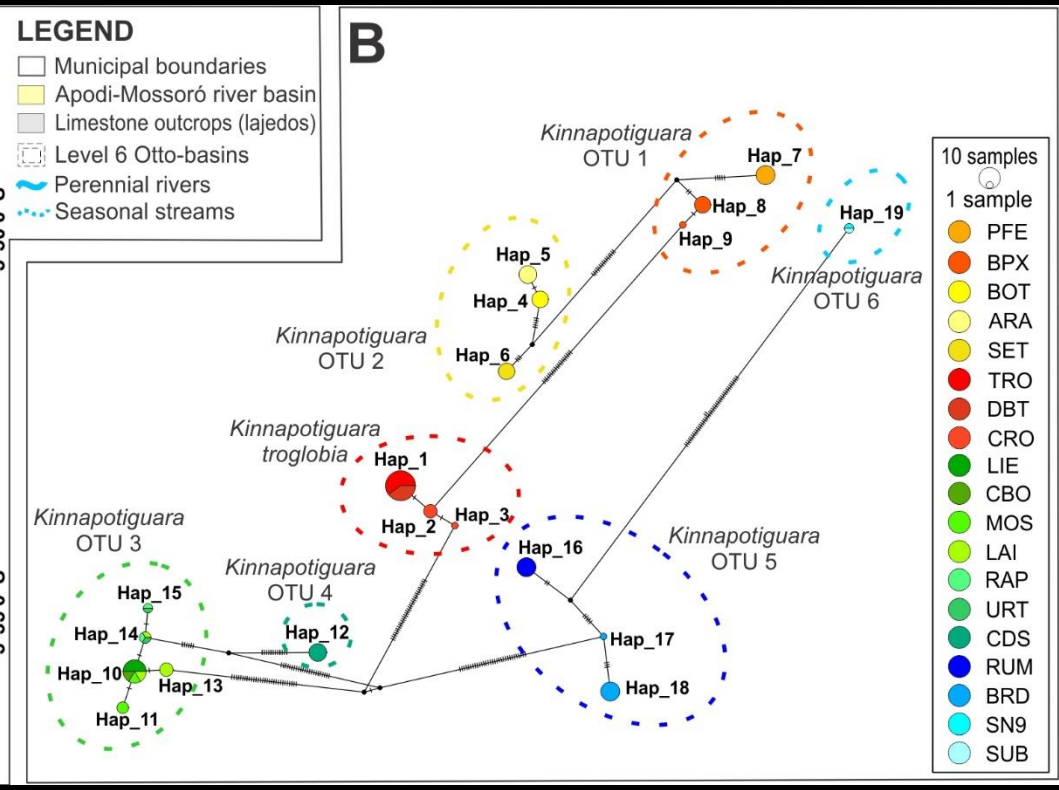
16 Gêneros

01 Sub-famílias

02 Famílias

01 Sub-ordem


A
37°40'0"W
37°35'0"W
5°30'0"S
5°35'0"S
N
W
E
S
Felipe Guerra
Bonito outcrop
BPX
PFE
SN9
SUB
Angicos outcrop
Arapuá outcrop
BOT
ARA
SET
GDS Rosado
Rosário outcrop
Lapa outcrop
TRO
CRO
Rumana outcrop
LIE
LAI
RAP
MOS
URT
DBT
RUM
CBO
CDS
Alfredo outcrop
BRD
Meio outcrop
Apodi-Mossoró river
0 1,25 2,5 5
KILOMETERS


LEGEND
Municipal boundaries
Apodi-Mossoró river basin
Limestone outcrops (lajedos)
Level 6 Otto-basins
Perennial rivers
Seasonal streams
B
Kinnapotiguara OTU 1
Hap_7
Hap_8
Hap_9
Hap_19
Kinnapotiguara OTU 6
Hap_5
Hap_4
Hap_6
Kinnapotiguara OTU 2
Kinnapotiguara troglobia
Hap_1
Hap_2
Hap_3
Kinnapotiguara OTU 3
Kinnapotiguara OTU 4
Hap_16
Kinnapotiguara OTU 5
Hap_15
Hap_14
Hap_12
Hap_17
Hap_10
Hap_13
Hap_18
Hap_11
10 samples
1 sample
PFE
BPX
BOT
ARA
SET
TRO
DBT
CRO
LIE
CBO
MOS
LAI
RAP
URT
CDS
RUM
BRD
SN9
SUB









IN VITRO EVALUATION OF THE ANTICANCER ACTIVITY OF FILAMENTOUS FUNGAL EXTRACTS

Marco Antônio Lanza Bernardo[1,4*], Christiane Contigli[1], Patrícia Gomes Cardoso[2], Dérica Gonçalves Tavares[2], Bárbara Viana Lessa Barbosa[2], Rodrigo Lopes Ferreira[2], Letícia Conceição Braga[1,3], Luciana Maria Silva[1]

[1] Cell Biology Service, Department of Research and Development, Ezequiel Dias Foundation - FUNED, Belo Horizonte (MG), Brazil

[2] Department of Biology, Federal University of Lavras - UFLA, Lavras (MG), Brazil

[3] UNA University Center, Belo Horizonte (MG), Brazil

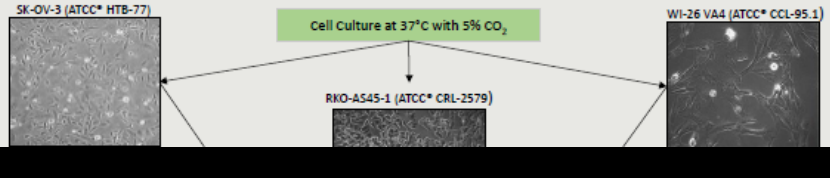
[4] Faculty of Pharmacy, Federal University of Minas Gerais - UFMG, Belo Horizonte (MG), Brazil

Contact: marcoantoniolanza@hotmail.com; FUNED phone 55 31 33144909; cell number 55 31 984804025

ABSTRACT

Cancer is a serious public health problem, affecting millions of people worldwide. Among them, colorectal carcinoma is one of the most prevalent, while ovarian adenocarcinoma presents a lower chance of cure. Researchers has sought more selective drugs derived from biodiversity, and one source of biotechnological compounds are filamentous fungi, known to produce a variety of metabolites that aid their environmental adaptation. The present study evaluated the *in vitro* antitumoral effect of a collection of filamentous fungi, previously isolated from candeia tree (*Eremanthus* sp.) or Brazilian caves environment. Fungal extracts were obtained from filtered culture supernatants, just lyophilizated or submitted to ethyl acetate extraction. In MTT cytotoxicity assays, RKO-AS45-1 (colorectal carcinoma), SK-OV-3 (ovarian adenocarcinoma) and WI-26-VA4 (nontumoral lung fibroblasts, control) cell lines were incubated for 48 h with 0 100 µg/mL of fungal extracts, 1.4 µg/mL of Paclitaxel or DMSO 1%. Among 28 compounds, three extracts originated from cave strains, previously identified as *Penicillium flavigenum* and *Aspergillus sydowii*, presented relevant results. *P. flavigenum* E24 ethyl acetate fraction was cytotoxic to RKO-AS451-1 (IC_{50} 11.9 µg/ml) and to SK-OV-3 (IC_{50} 54 µg/mL). Furthemore, *P. flavigenum* L.E24 and *A. sydowii* L.GMA3 lyophilized extracts were effective only to RKO-AS45-1 (IC_{50} 21.6 and 213.0 µg/ml, respectively). The Selective Index (SI) for RKO-AS45-1 *versus* control line WI-26-VA4 was determined as 4.2 for E24, 2.24 for L.E24 and 65.72 for L.GMA3. The fungal extracts cytotoxicity will also be tested on other tumoral cell lines, and those with lower IC_{50} or SI>2 will be evaluated for *in vitro* effects on cell cycle kynetics, apoptosis and reproductive death.

METHODOLOGY



RESULTS

Table 1 - *In vitro* evaluation of fungal extracts cytotoxicity

Extract	Origin of the fungus		SK-OV-3		RKO-AS45-1		WI-26 VA4
			IC_{50} (µg/mL)	Selectivity Index*	IC_{50} (µg/mL)	Selectivity Index*	IC_{50} (µg/mL)
CF292	Coroa de Frade Cave / Air	Coronel José Dias/Piauí	ND	ND	57.0	0.5	31.3
L.CF292			ND	ND	ND	ND	ND

Formação de pesquisadores…

38 Mestres

7 Doutores

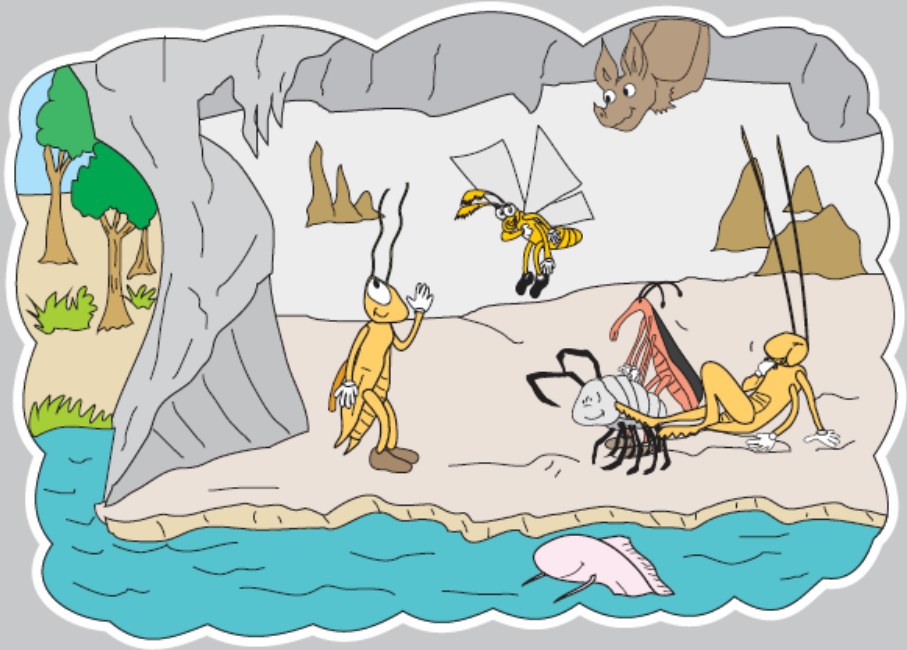
5 Pós-doutores


ÁLCOOL
TUP


Centro de Estudo em Biologia Subterrânea


PESQUISA
ESTUDOS AMBIENTAIS NA CAVERNA PARANOÁ
ESTUDOS AMBIENTAIS NA CAVERNA ÉDEN

A AVENTURA DA VIDA NAS CAVERNAS



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CONSELHO REGIONAL DE BIOLOGIA 4ª REGIÃO

Centro de Estudos em Biologia Subterrânea

MARIANE BIGIO

A VIDA NAS CAVERNAS

EM CORDEL

Fontes de financiamento para a pesquisa...

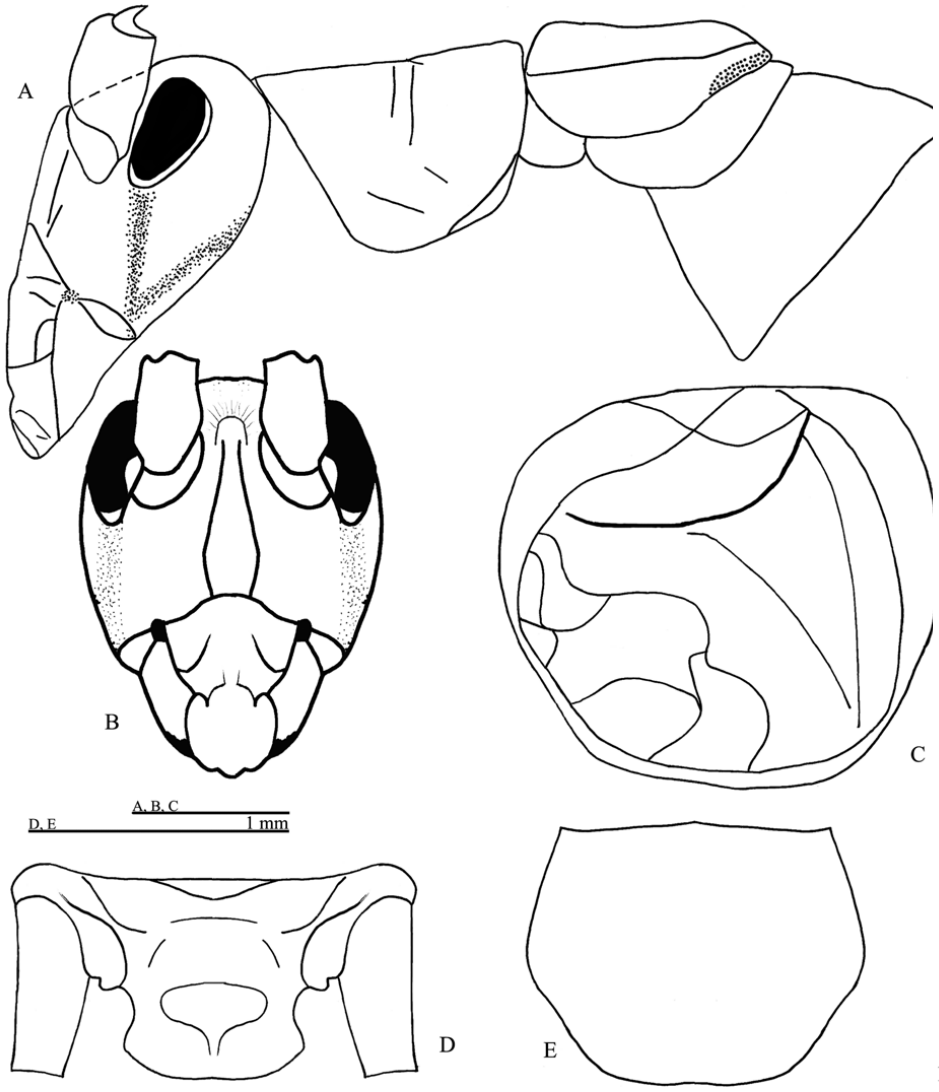

CNPq
Conselho Nacional de Desenvolvimento
Científico e Tecnológico


CAPES


FAPEMIG


CECAV
ICMBio-MMA


Axiocam 506 color
AxioZoom.V16
TM4000
HITACHI


A
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A, B, C
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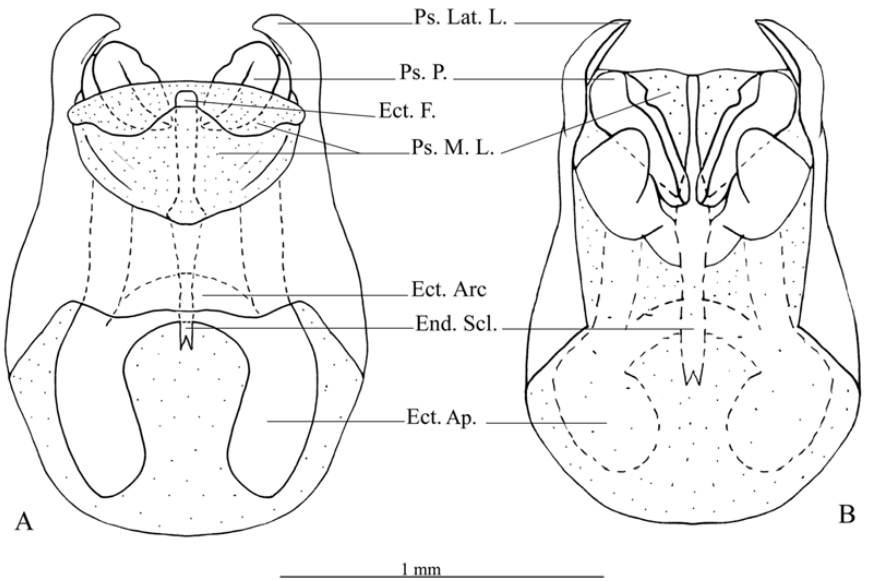
D
E

1


Ps. Lat. L.
Ps. P.
Ect. F.
Ps. M. L.
Ect. Arc
End. Scl.
Ect. Ap.
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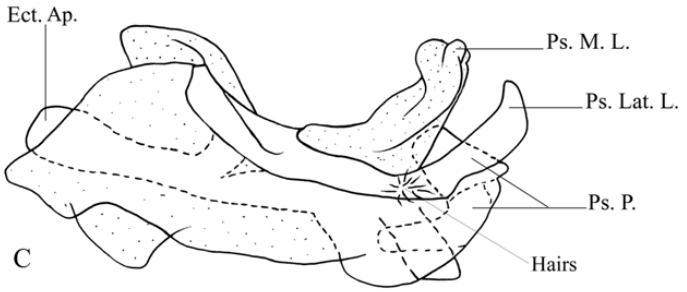
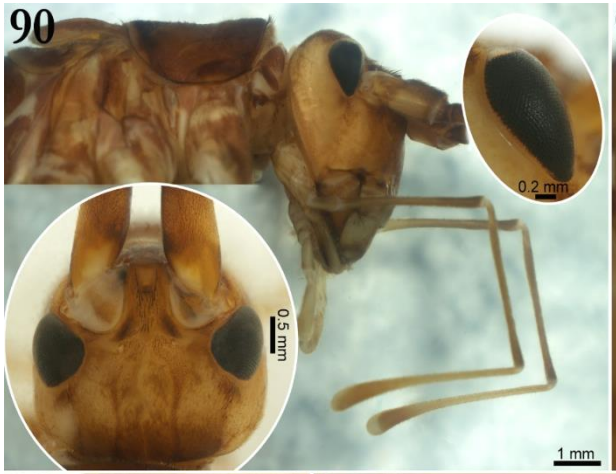

Ect. Ap.
Ps. M. L.
Ps. Lat. L.
Ps. P.
Hairs
C

2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91
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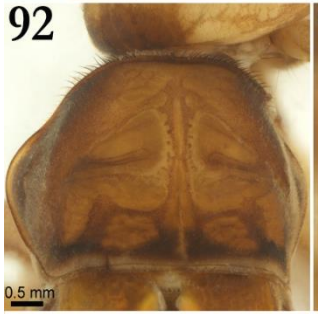
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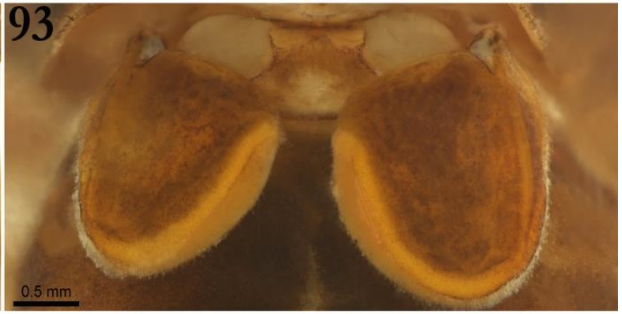
0.5 mm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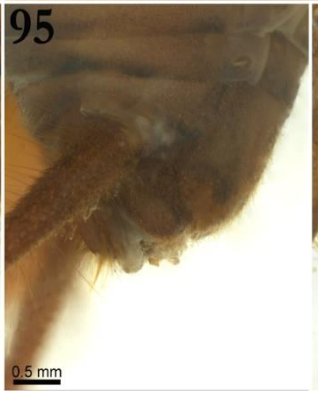
94
0.5 mm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96
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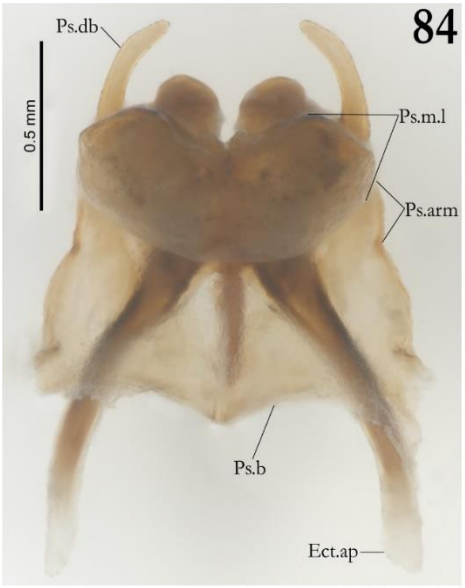
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Ps.m.l
Ps.arm
Ps.b
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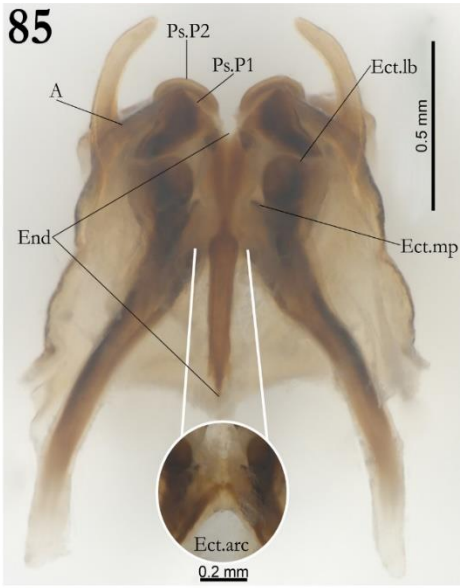
0.5 mm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A
End
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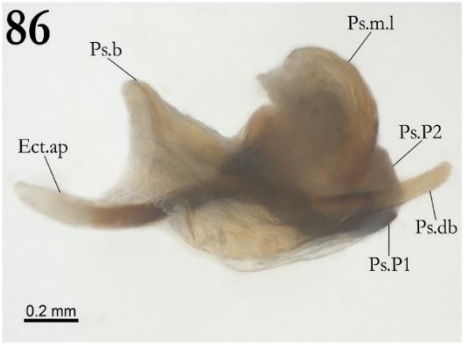
86
Ps.m.l
Ps.b
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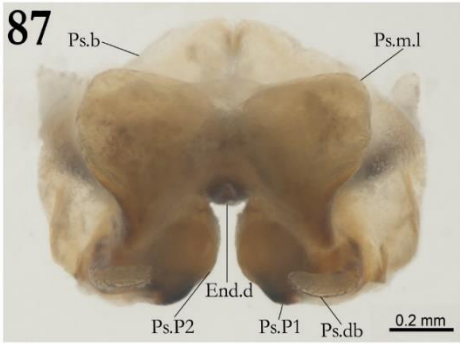
Ect.ap
Ps.db
Ps.P1
0.2 mm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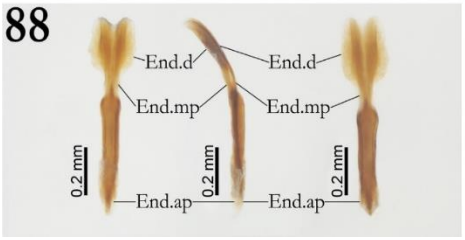
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End.d
End.mp
End.mp
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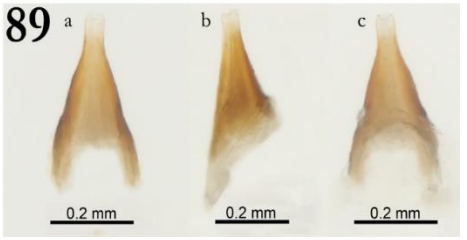
0.2 mm
0.2 mm
End.ap
End.ap


89
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c
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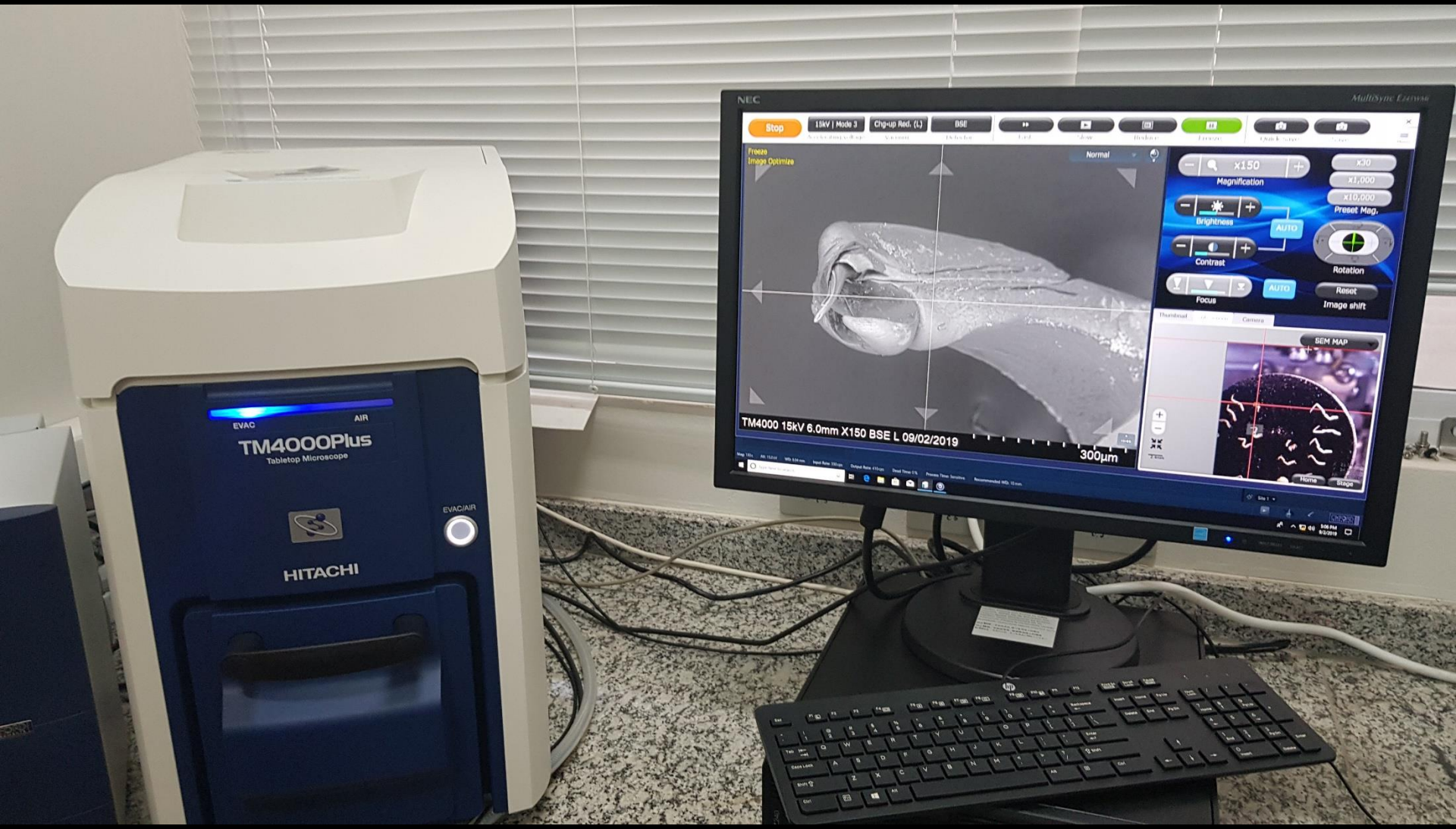
0.2 mm
0.2 mm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Tabletop Microscope
EVAC/AIR
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NEC
Stop
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Chg-up Red. (L)
BSE
Freeze
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x30
x1,000
x10,000
Preset Mag.
Brightness
AUTO
Contrast
Rotation
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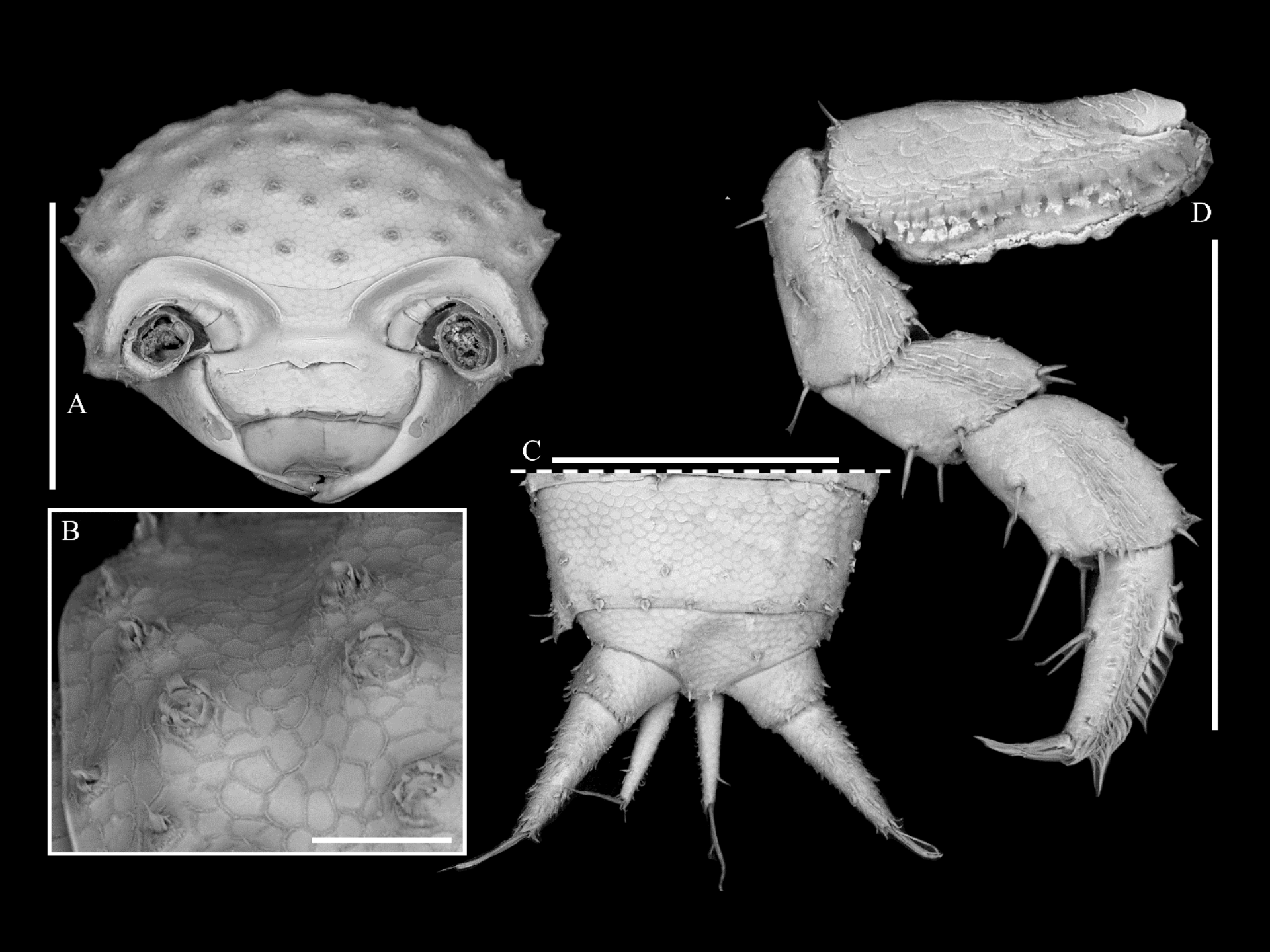
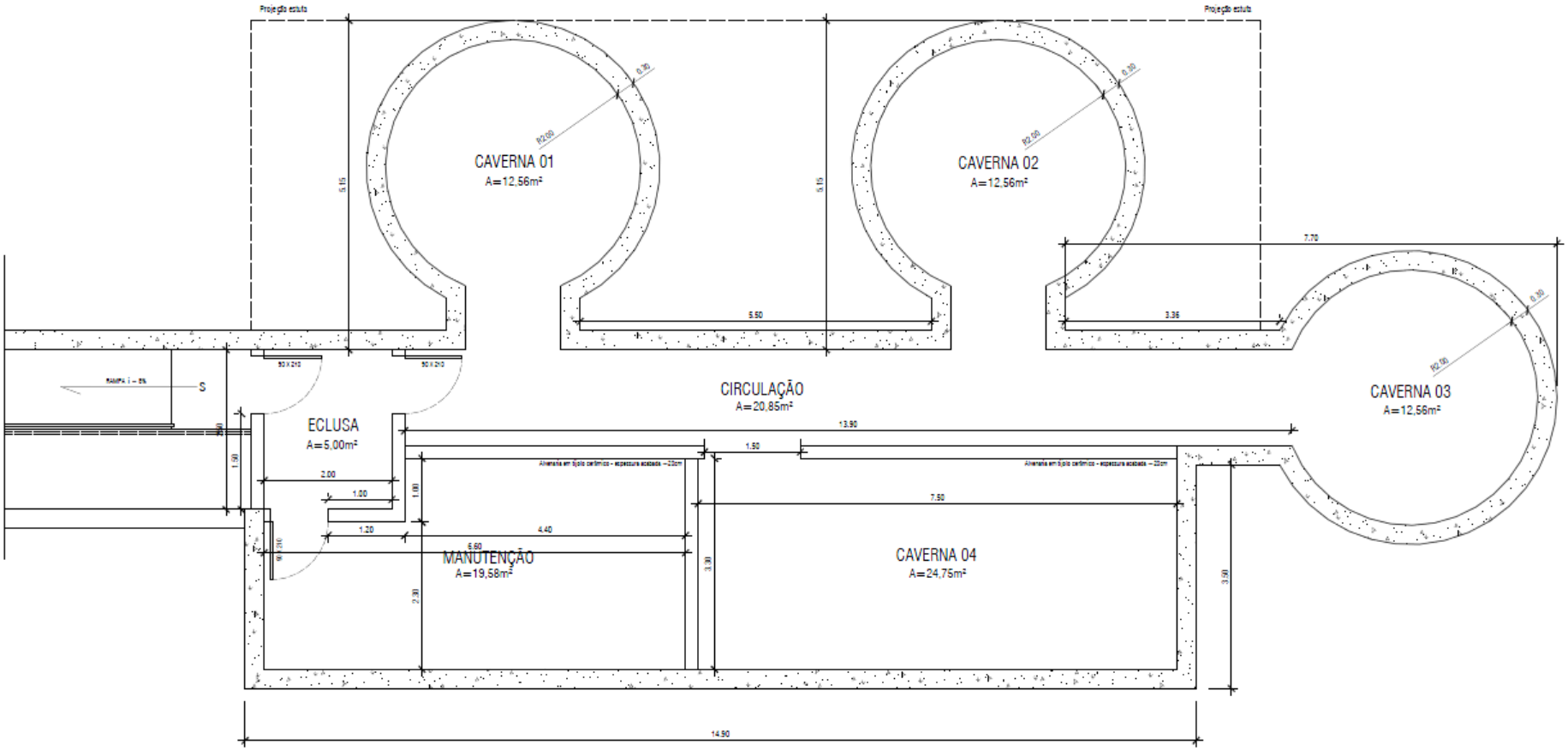
AUTO
Reset
Image shift
SEM MAP
TM4000 15kV 6.0mm X150 BSE L 09/02/2019
300µm


A
B
C
D


Perspectivas futuras...



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01 ESCALA 1/75

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