



South African
NATIONAL PARKS

SAVANNA SCIENCE NETWORK MEETING 2025



FAPESP
SÃO PAULO RESEARCH FOUNDATION

#2020/12658-4

#2020/01378-0

IMPACTS OF WOODY ENCROACHMENT AND PRESCRIBED FIRE ON SMALL MAMMAL COMMUNITIES IN A TROPICAL SAVANNA:

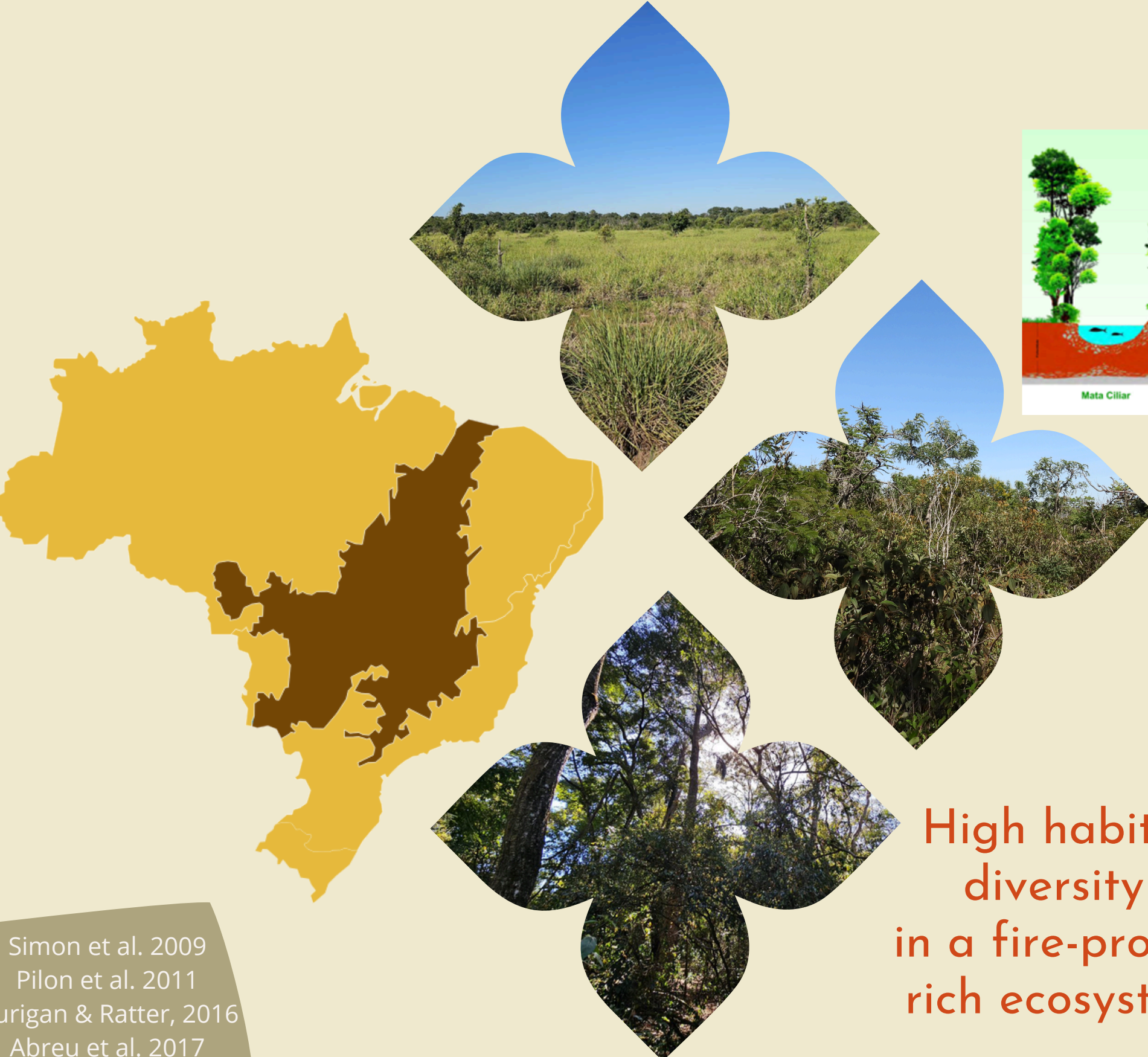
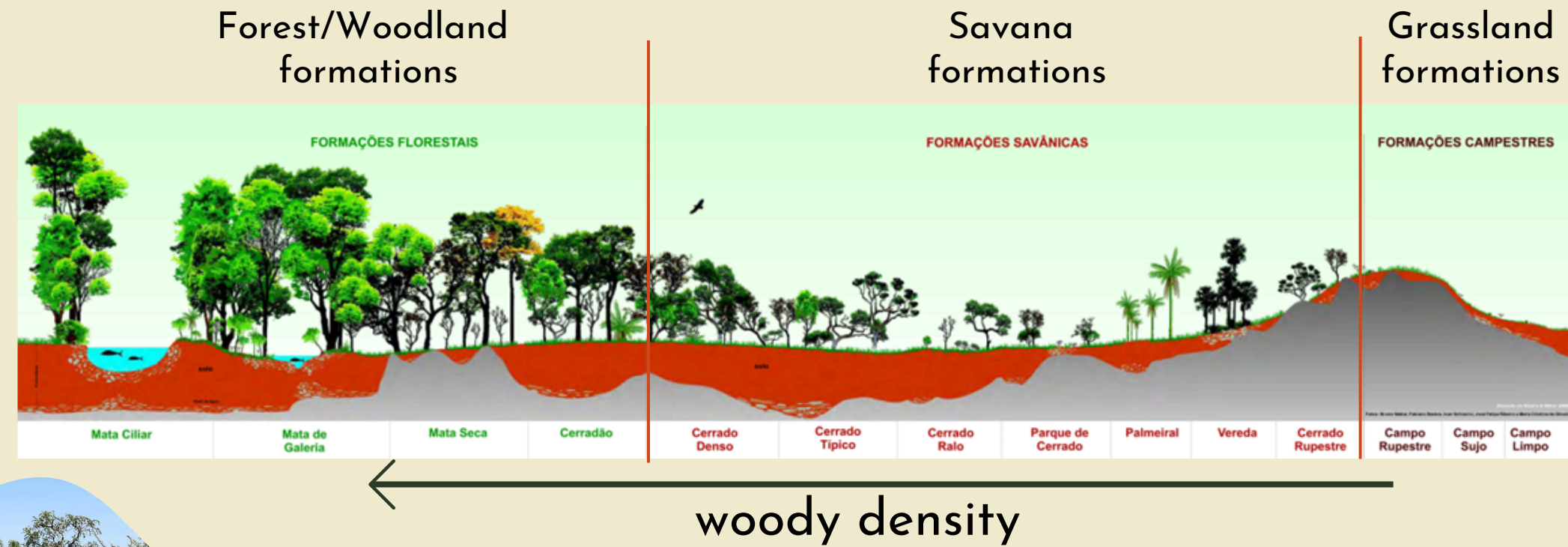
Contributions to conservation through
fire management

Furtado, L.O., Felício, G. R., Lemos, P. R., Christianini, A. V., Durigan, G., Percequillo, A. R., Martins, M. & Carmignotto, A. P.



BRAZILIAN CERRADO

A biodiversity hotspot and the largest savanna in South America



High habitat diversity in a fire-prone, rich ecosystem



Simon et al. 2009
 Pilon et al. 2011
 Durigan & Ratter, 2016
 Abreu et al. 2017

Simon et al. 2009

Photos:Luciana Furtado

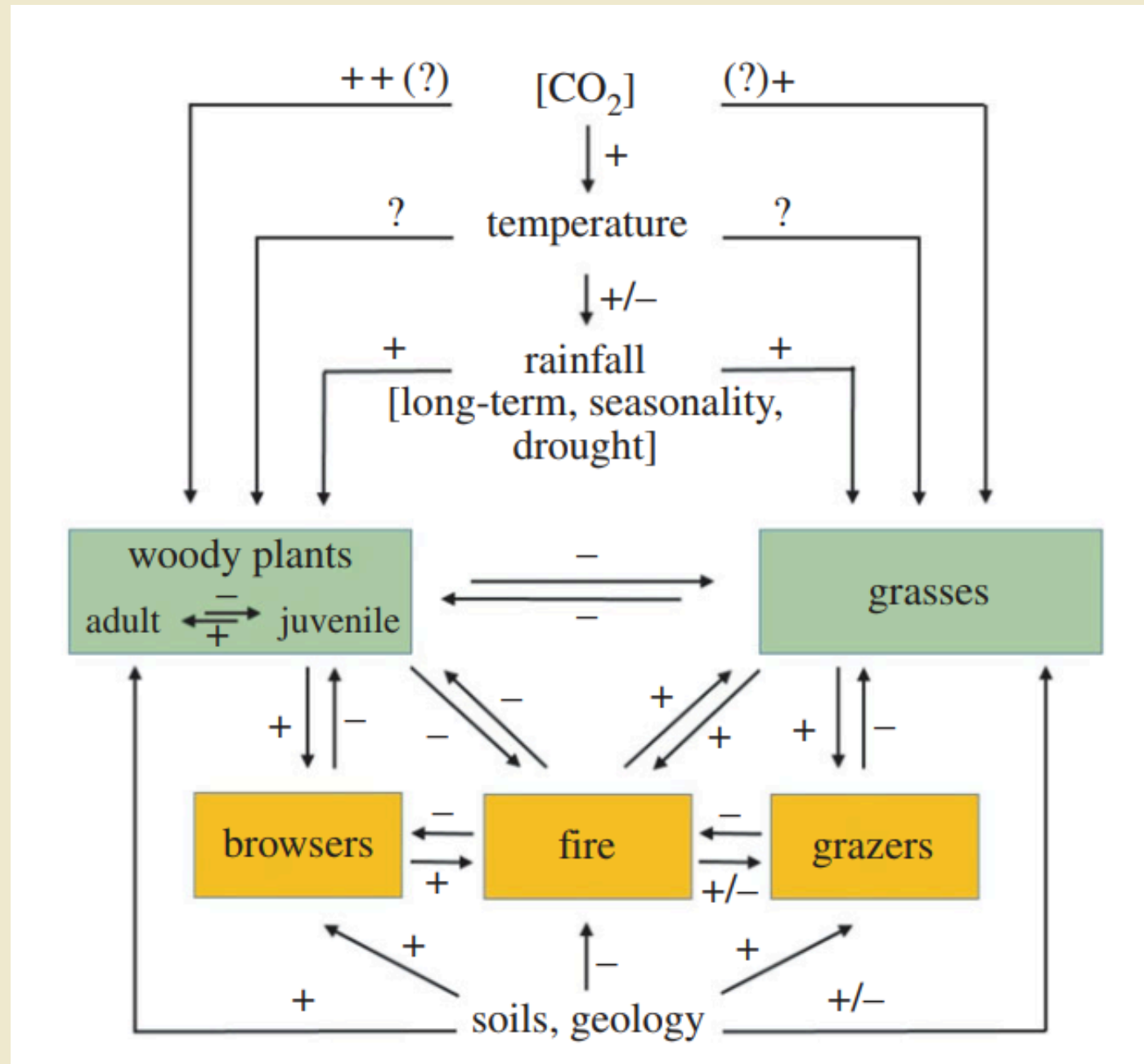
FIRE SUPPRESSION AND ITS CONSEQUENCES

Alteration of complex natural cycles

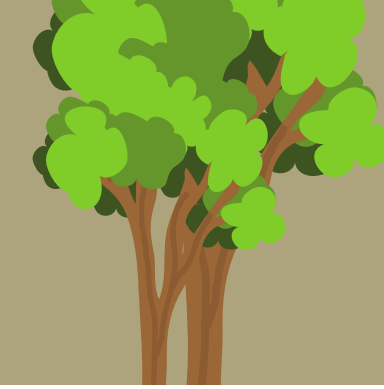
30 years of fire suppression policies



Deforestation
Extreme dry periods
Wildfires
and more..



THE CERRADO IS CHANGING



19% of Cerrado is under woody encroachment

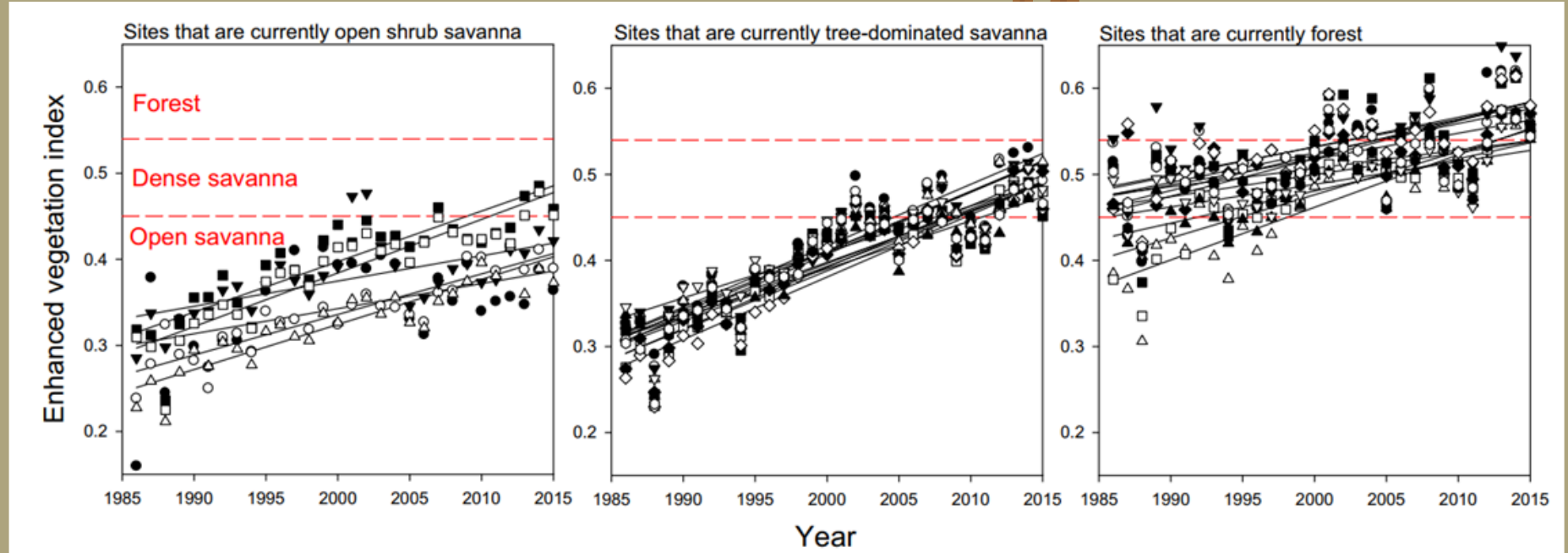
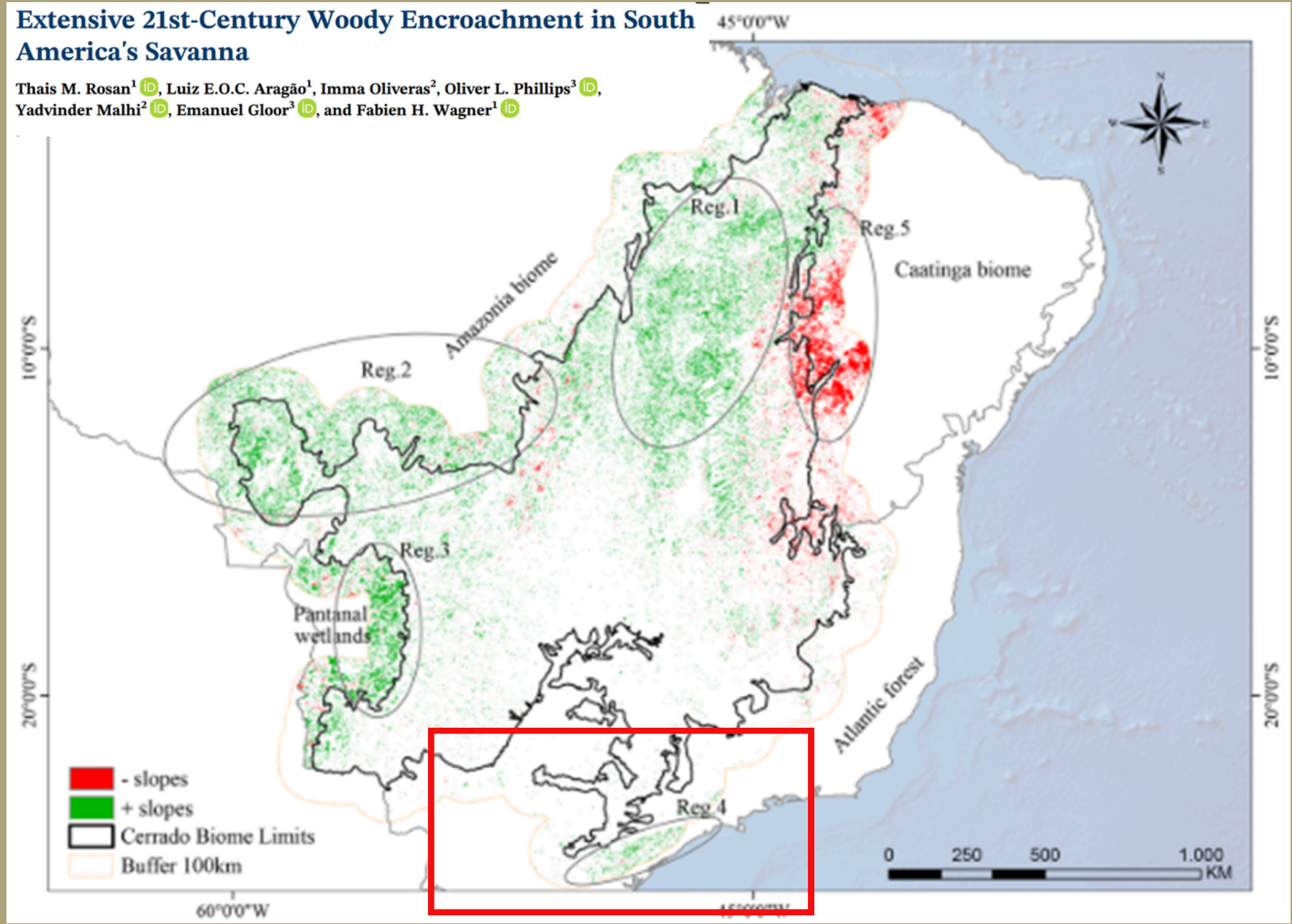


Fig. 1. Historical changes in EVI over 30 years of fire suppression. Historical changes in the EVI over 30 years of fire suppression, as determined by Landsat images. Each study plot is denoted by a different symbol and a separate regression line.

Same area, 15 years later!



Photo: Ana Paula Carmignotto

Photo: Luciana Furtado

LOSS OF OPEN-HABITAT SPECIALISTS!

- Stevens et al., 2016
- Abreu et al., 2017
- Archer et al., 2017
- Rosan et al., 2019

HOW ARE VERTEBRATES IMPACTED BY WOODY ENCROACHMENT?

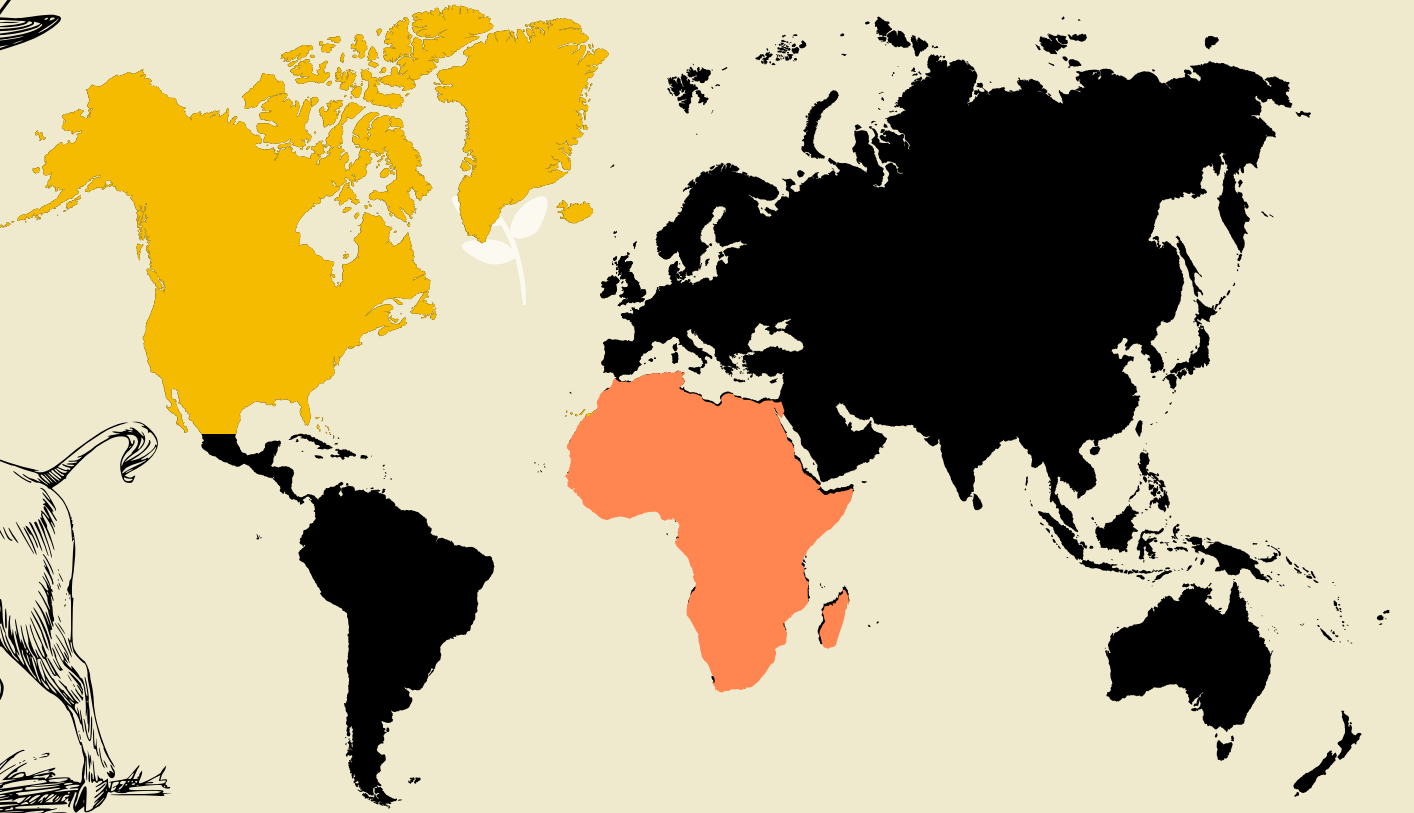
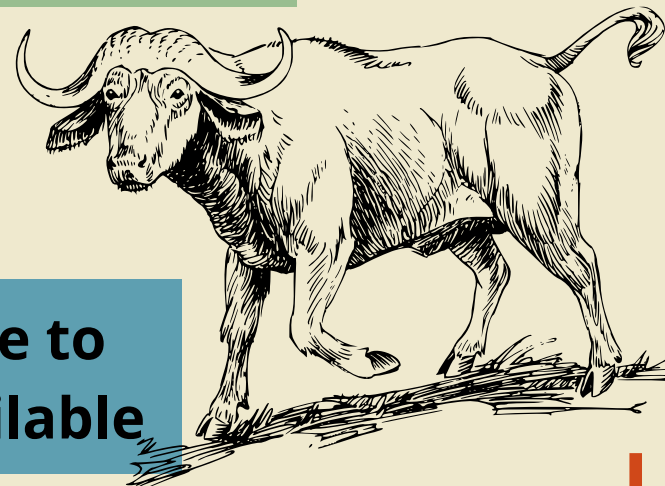
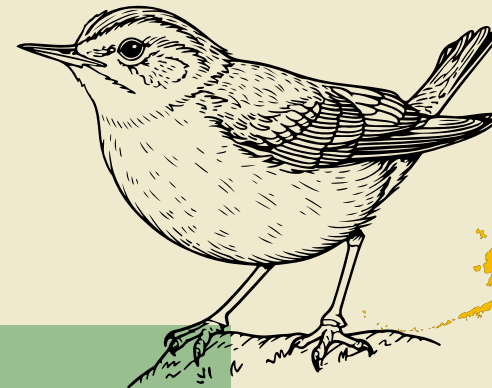
Shrub encroachment and vertebrate diversity:
A global meta-analysis

Richard A. Stanton Jr¹ | Wesley W. Boone IV² | Jose Soto-Shoender² |
Robert J. Fletcher Jr² | Niels Blaum³ | Robert A. McCleery²

Birds represent the majority of vertebrate studies

Mammals, amphibians, and reptiles declined due to woody encroachment in Africa – limited data available

Few studies focused on small mammals
(rodents and marsupials)



Limited data on Australian,
European and
South American fauna

QUESTIONS

How do small mammals respond to woody encroachment in a South American savanna?

How do small mammals use the Cerrado habitats?

How do small mammals respond to a prescribed fire event?

Rodents



Marsupials



SMALL MAMMAL RESPONSES TO WOODY ENCROACHMENT IN A SOUTH AMERICAN SAVANNA

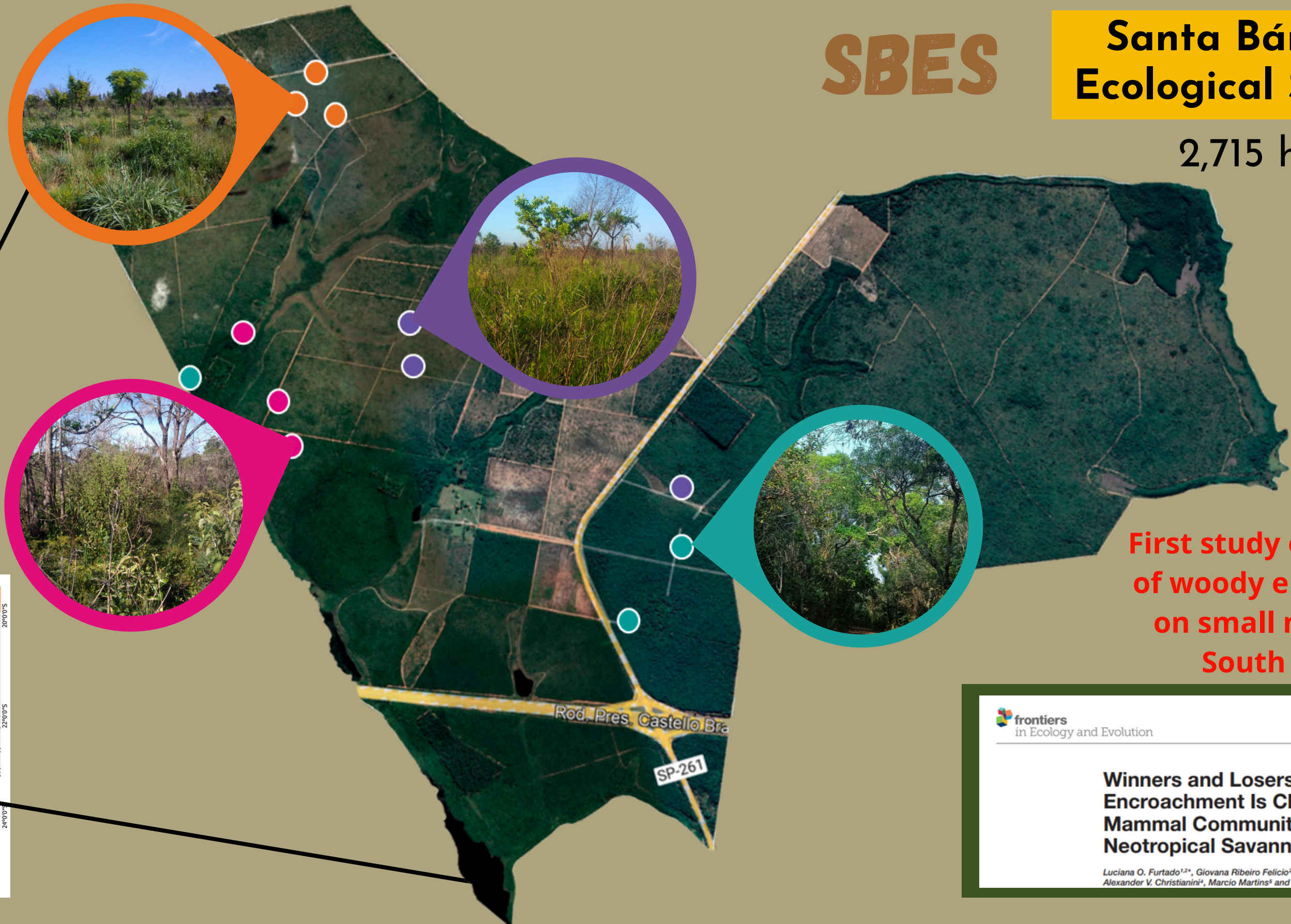
SBES

Santa Bárbara Ecological Station

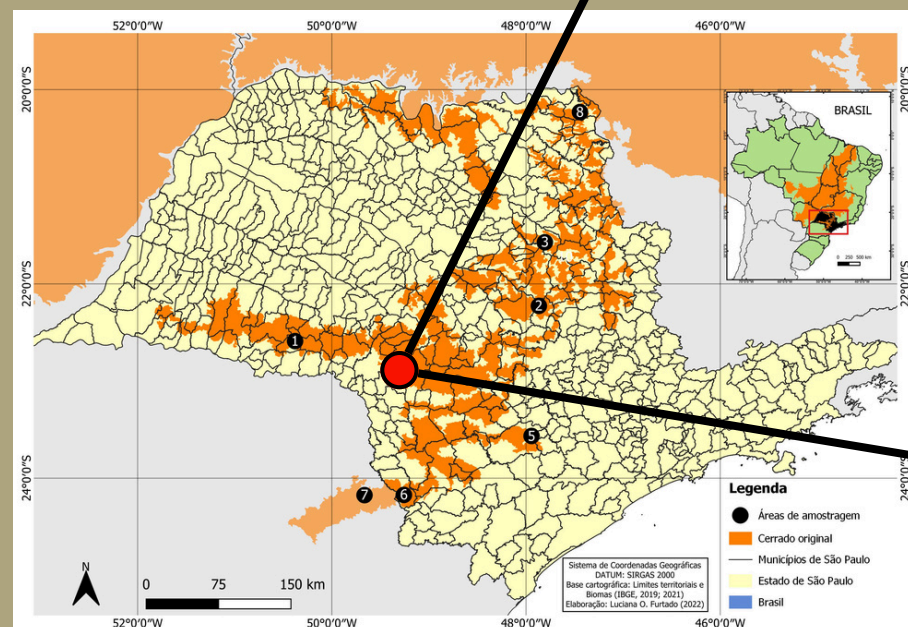
2,715 ha



Data collected
2003
2018



First study on the effects of woody encroachment on small mammals in South America



frontiers
in Ecology and Evolution

ORIGINAL RESEARCH
published: 16 December 2021
doi: 10.3389/fevo.2021.774744

Winners and Losers: How Woody Encroachment Is Changing the Small Mammal Community Structure in a Neotropical Savanna

Luciana O. Furtado^{1,2*}, Giovana Ribeiro Felício², Paula Rocha Lemos³, Alexander V. Christianini⁴, Marcio Martins⁵ and Ana Paula Carmignotto⁶

METHODOLOGY

SMALL MAMMAL
SURVEY



+



+



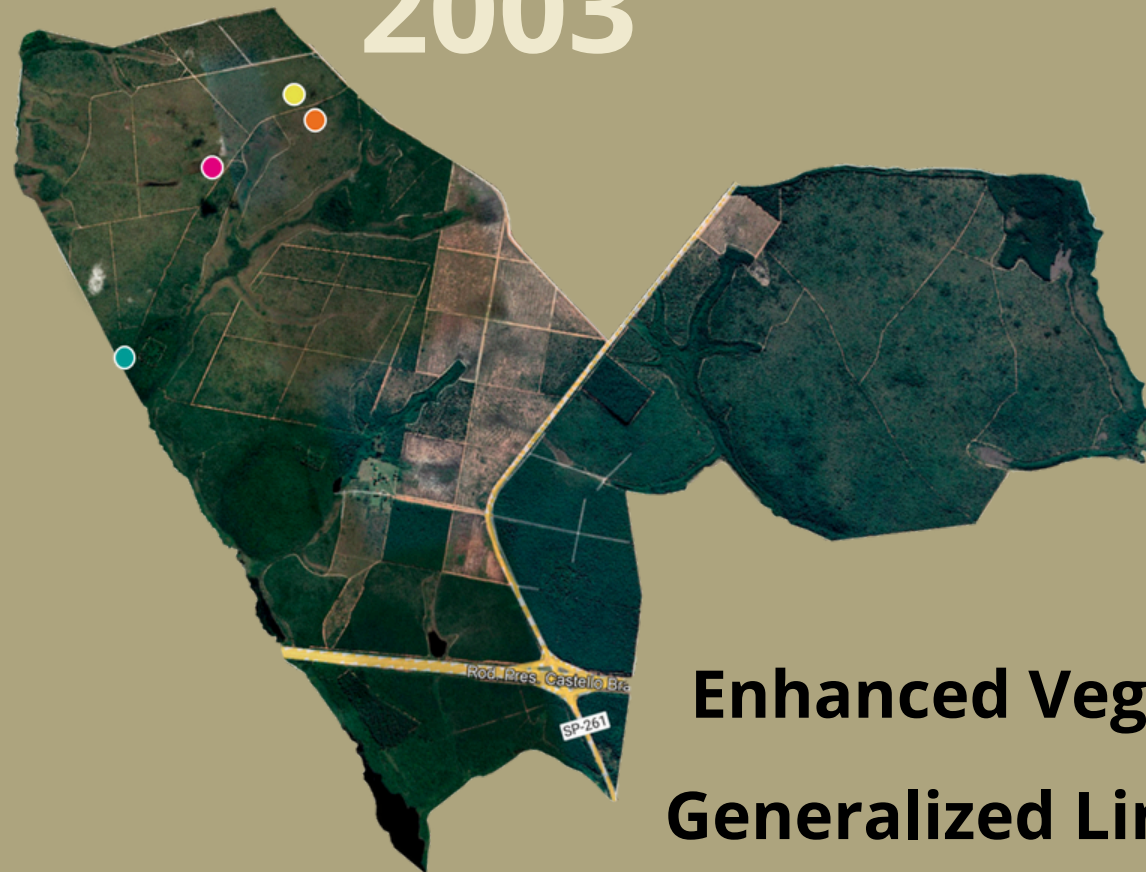
Live-traps + Pitfalls

Photos: Luciana Furtado

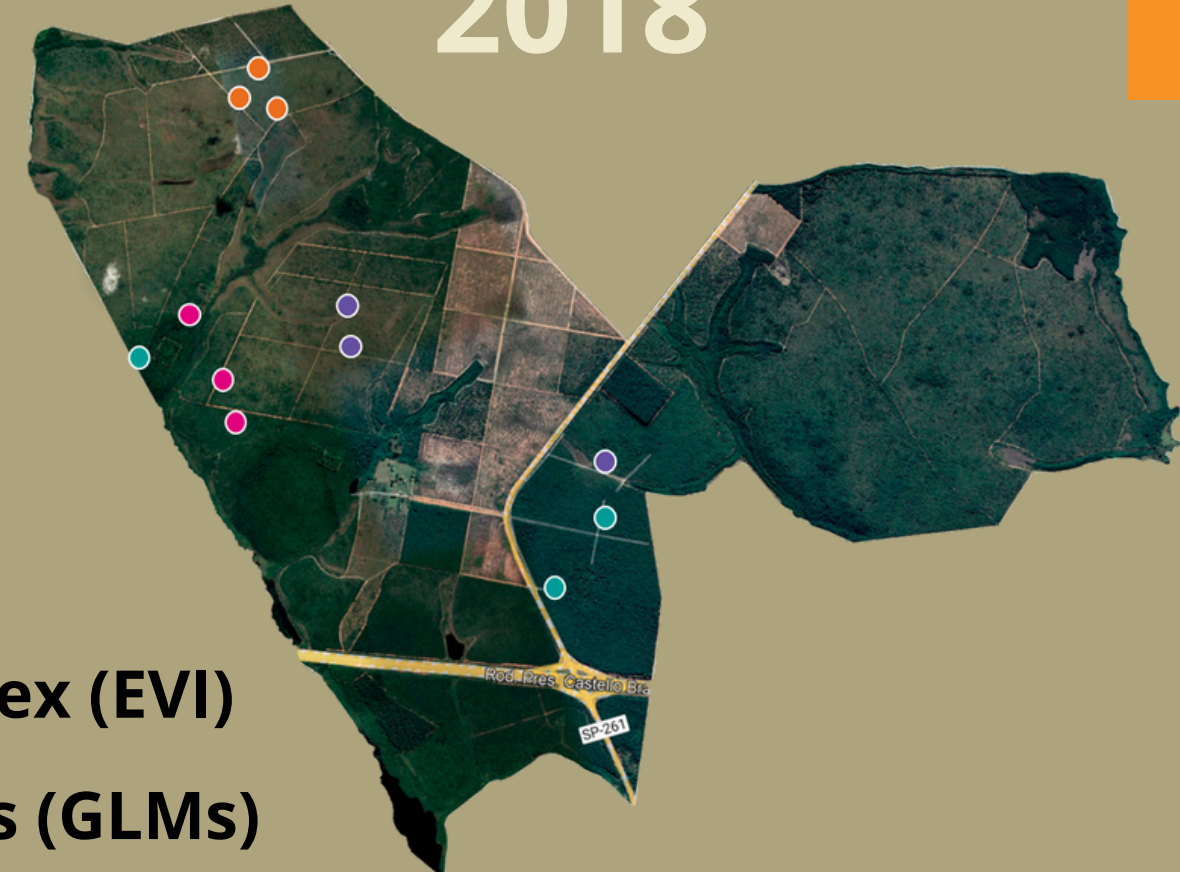


WOODY
ENCROACHMENT

2003



2018



Enhanced Vegetation Index (EVI)
Generalized Linear Models (GLMs)

TAXONOMIC DIVERSITY

RESULTS

Marsupials

Richness
6 species



Cryptonanus chacoensis



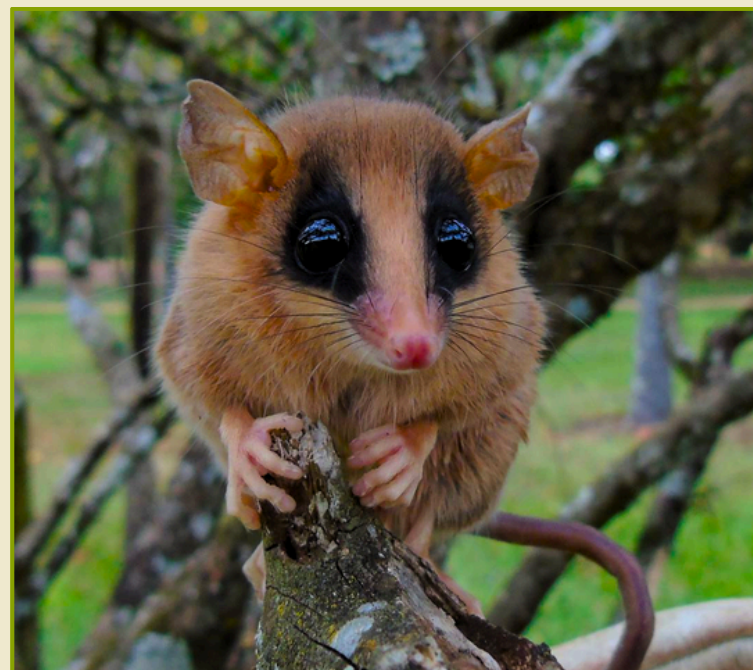
Cryptonanus aff. chacoensis



Didelphis albiventris



Gracilinanus agilis



Gracilinanus microtarsus



Monodelphis kungsi

TAXONOMIC DIVERSITY

RESULTS

Rodents



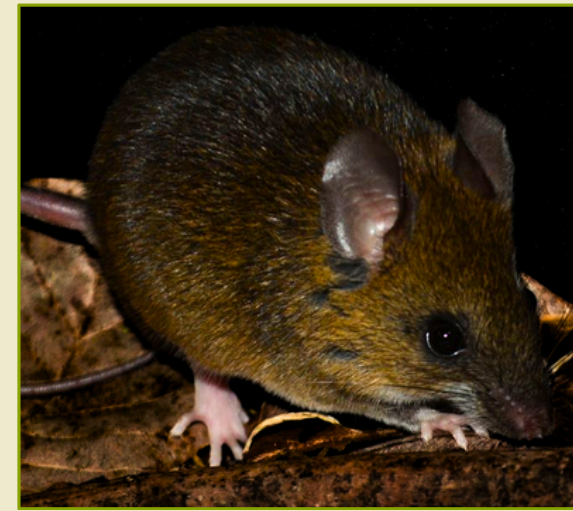
Akodon montensis



Calomys tener



Cerradomys scotti



Hylaeamys megacephalus



Necromys lasiurus



Nectomys squamipes



Oligoryzomys mattogrossae



Oligoryzomys nigripes



Oxymycterus delator



Rhipidomys macrurus



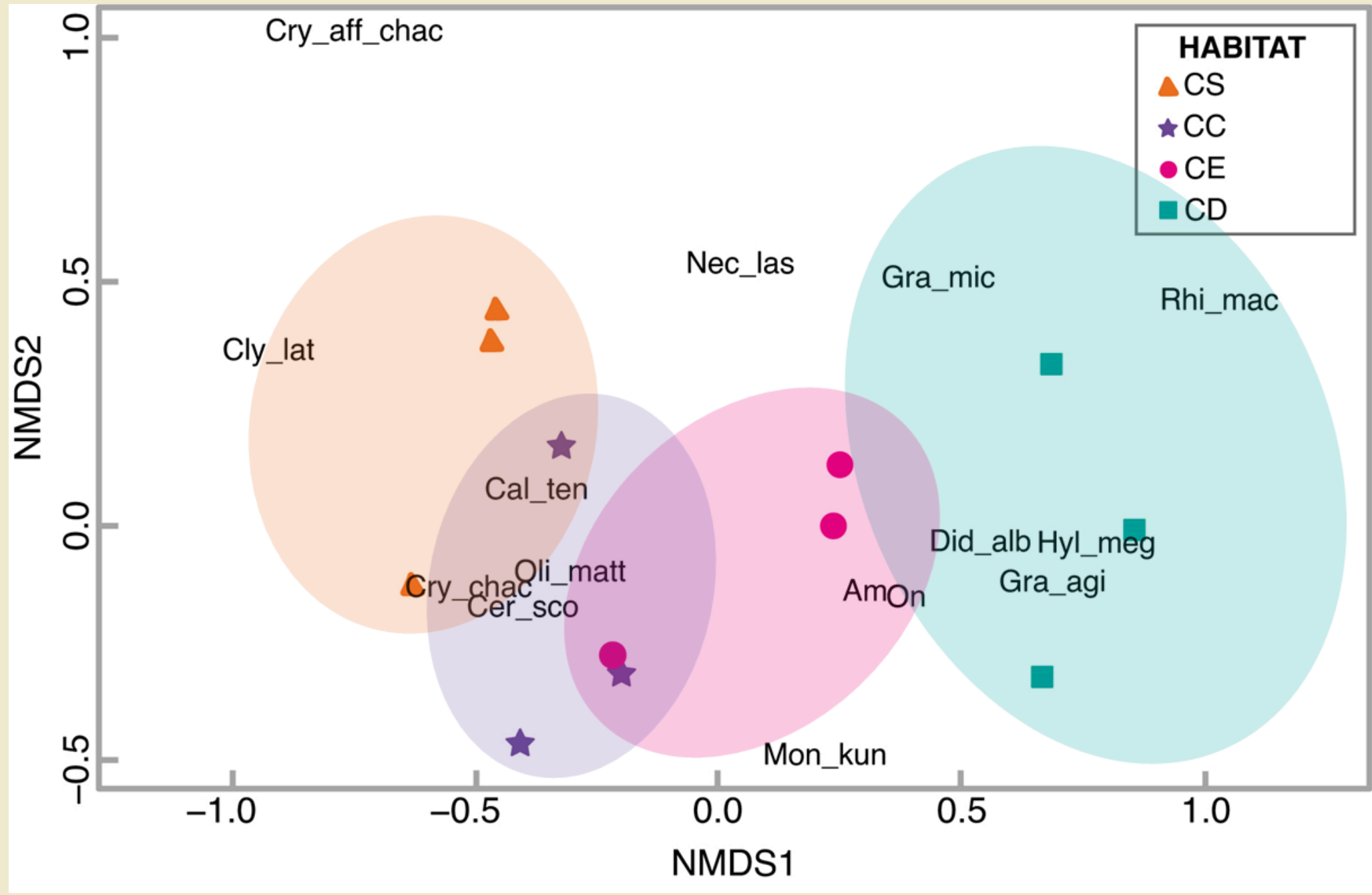
Clyomys laticeps

**Richness:
11 species**

HABITAT USE

RESULTS

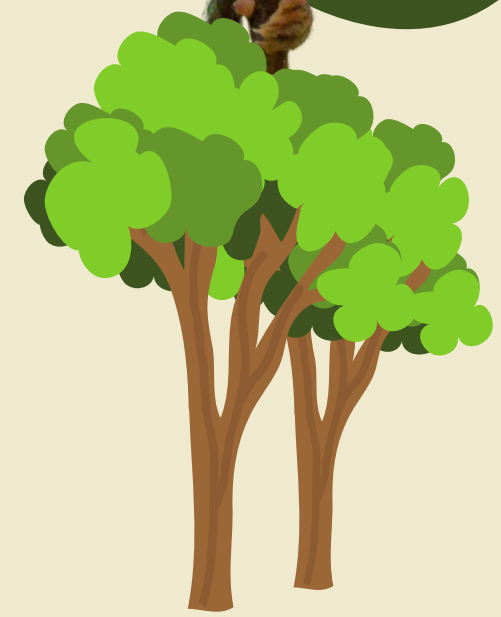
 **Grassland specialists**
 **Savanna specialists**
 **Forest specialists**



Cryptonanus chacoensis

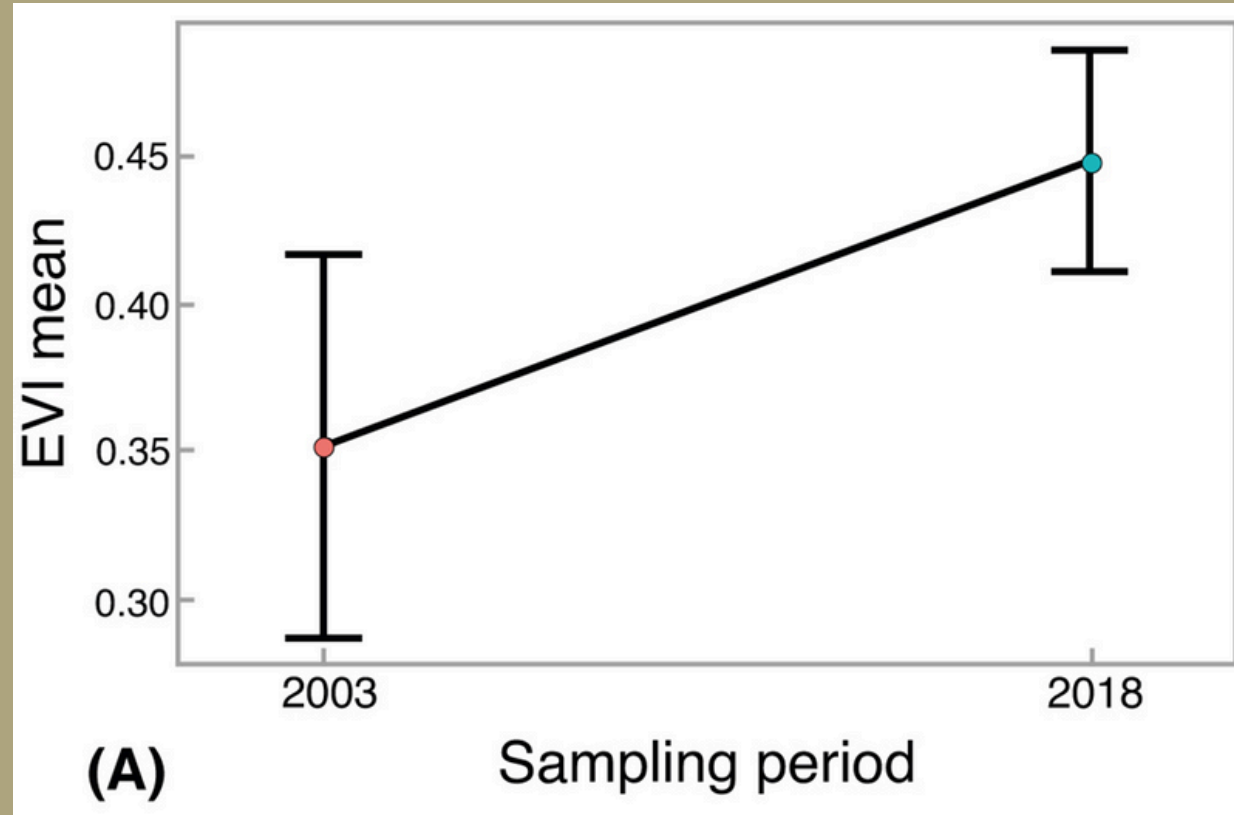
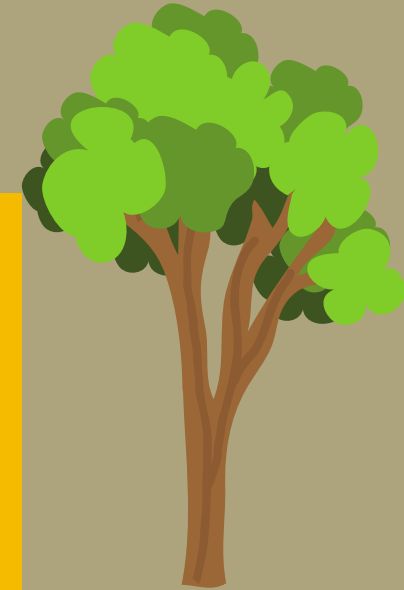


Gracilinanus agilis



Woody density

WOODY ENCROACHMENT AT SBES



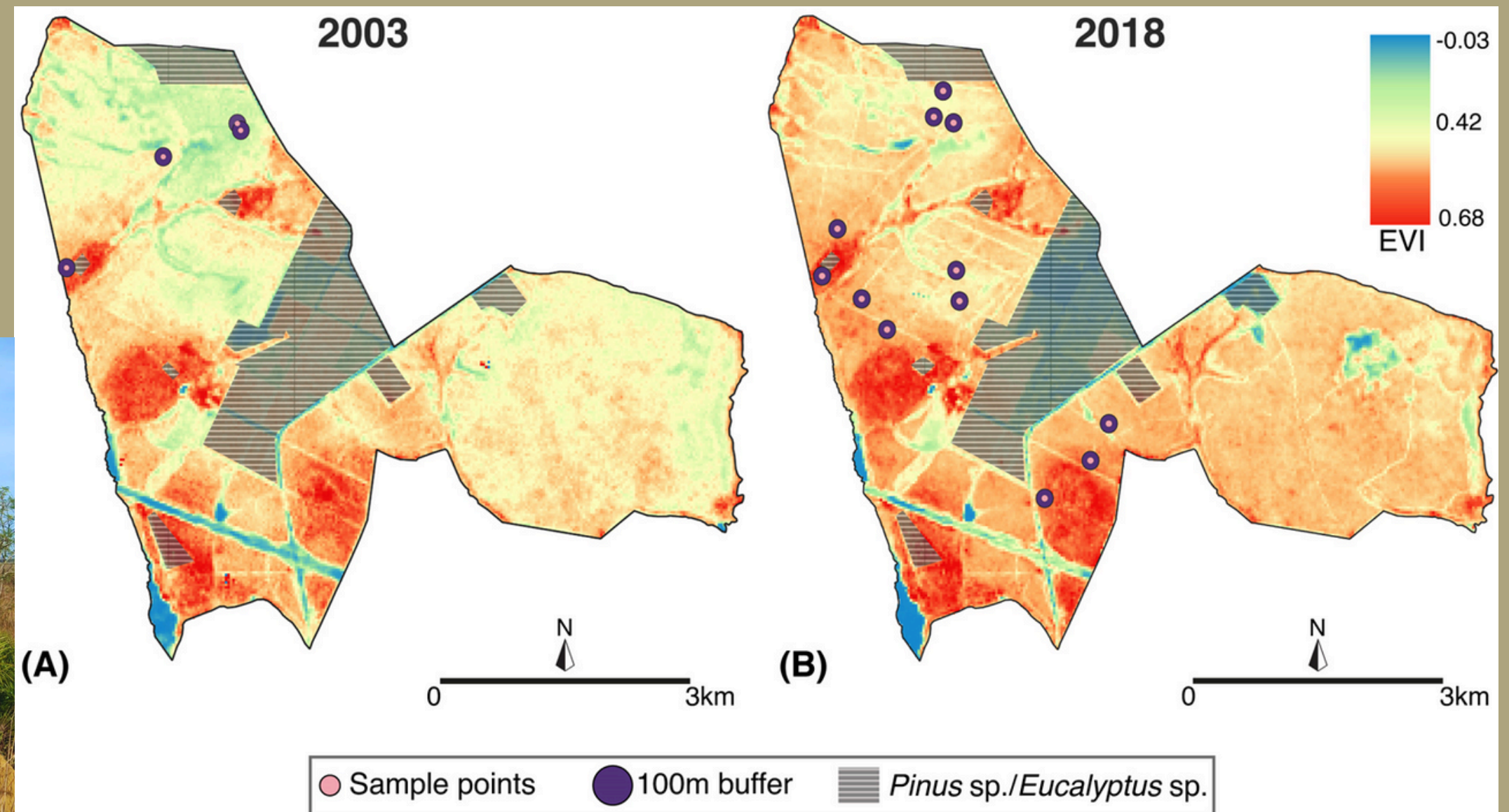
Wood density increased
27% in 15 years



Photo: Ana Paula Carmignotto



Photo: Luciana Furtado

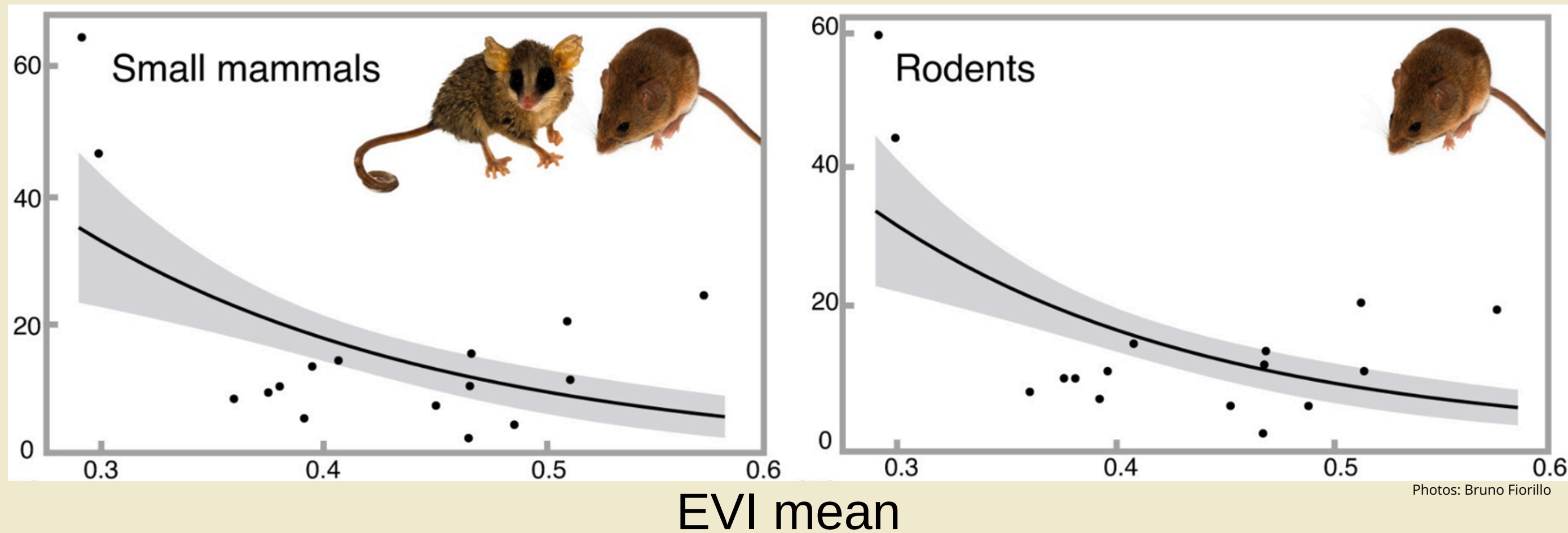


SMALL MAMMAL RESPONSES

RESULTS

Woody encroachment

Rodent abundance: negatively affected

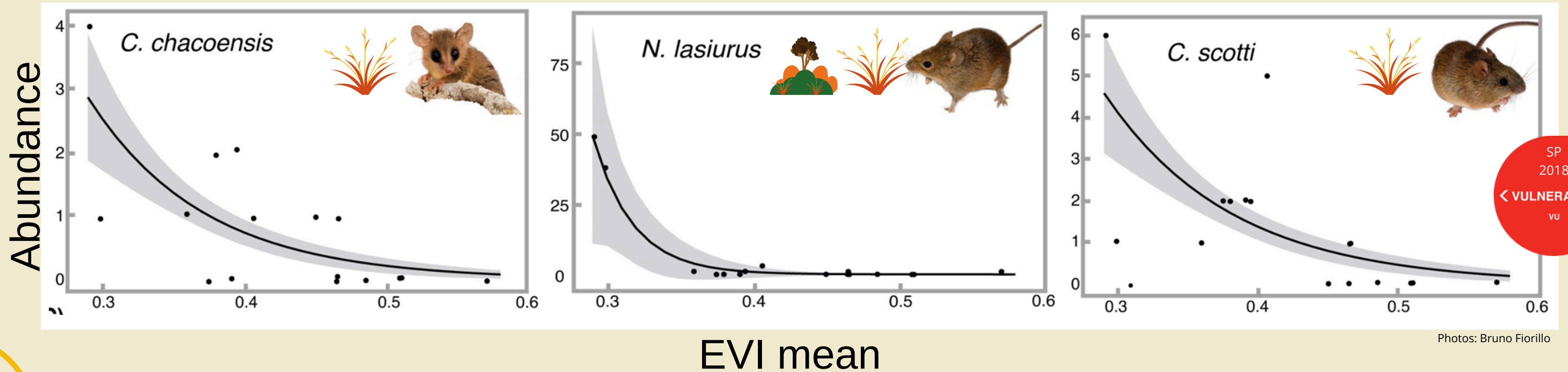


Small mammal richness and
marsupial abundance: not affected

SMALL MAMMAL RESPONSES

Woody encroachment

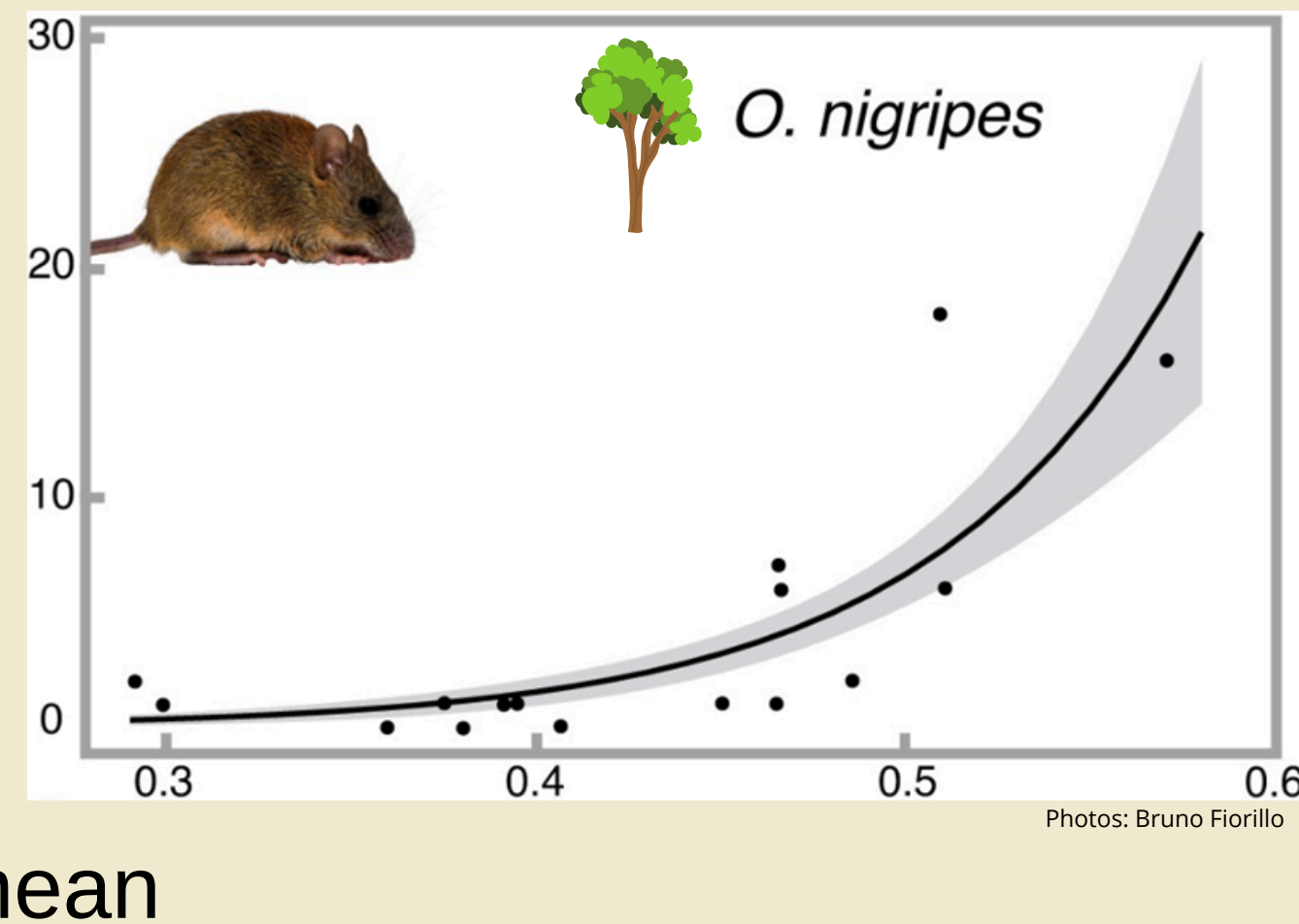
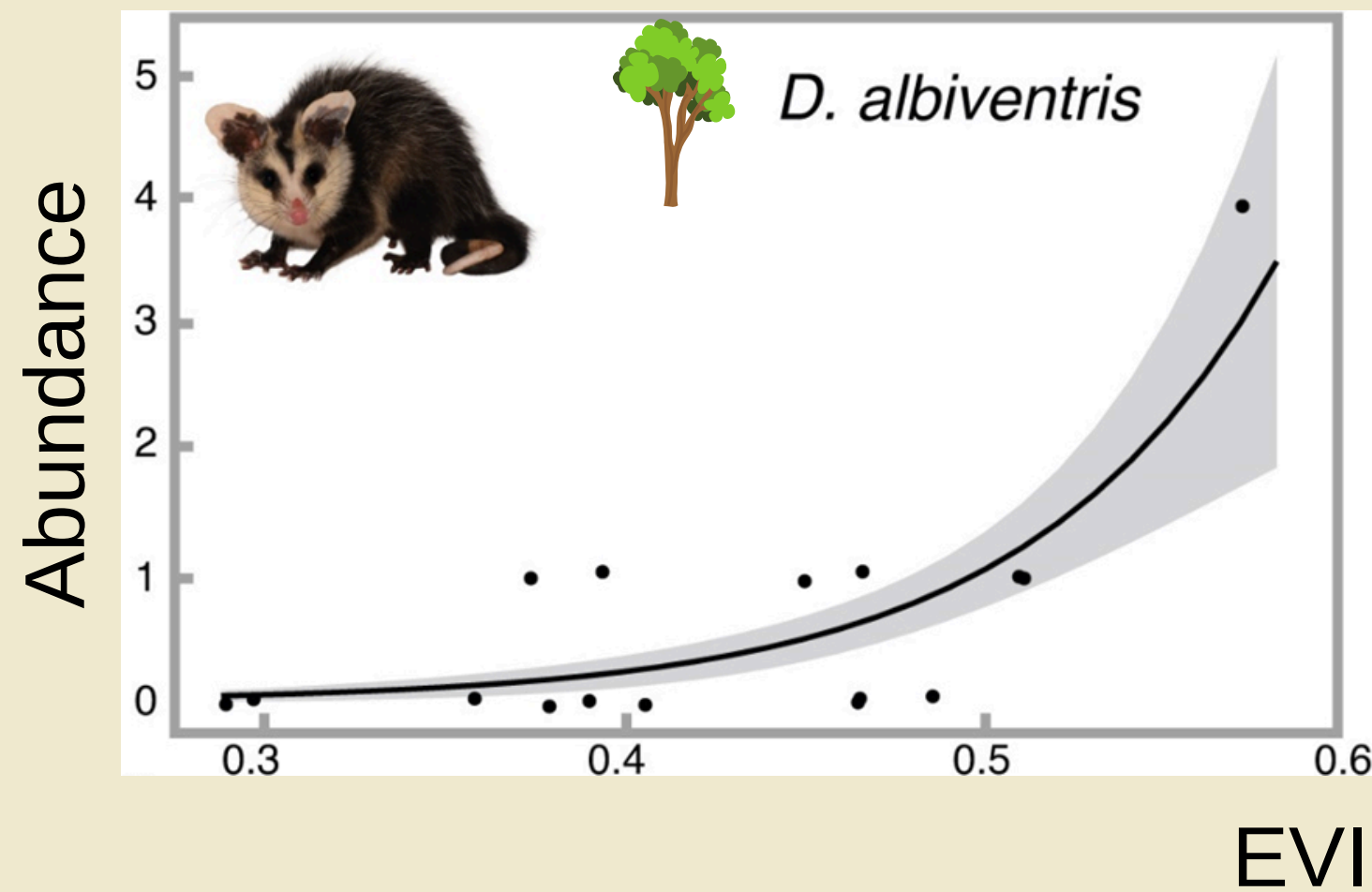
Open-area specialists:
declined with encroachment



SMALL MAMMAL RESPONSES

Woody encroachment

Forest dwellers: positively affected by woody encroachment



Photos: Bruno Fiorillo



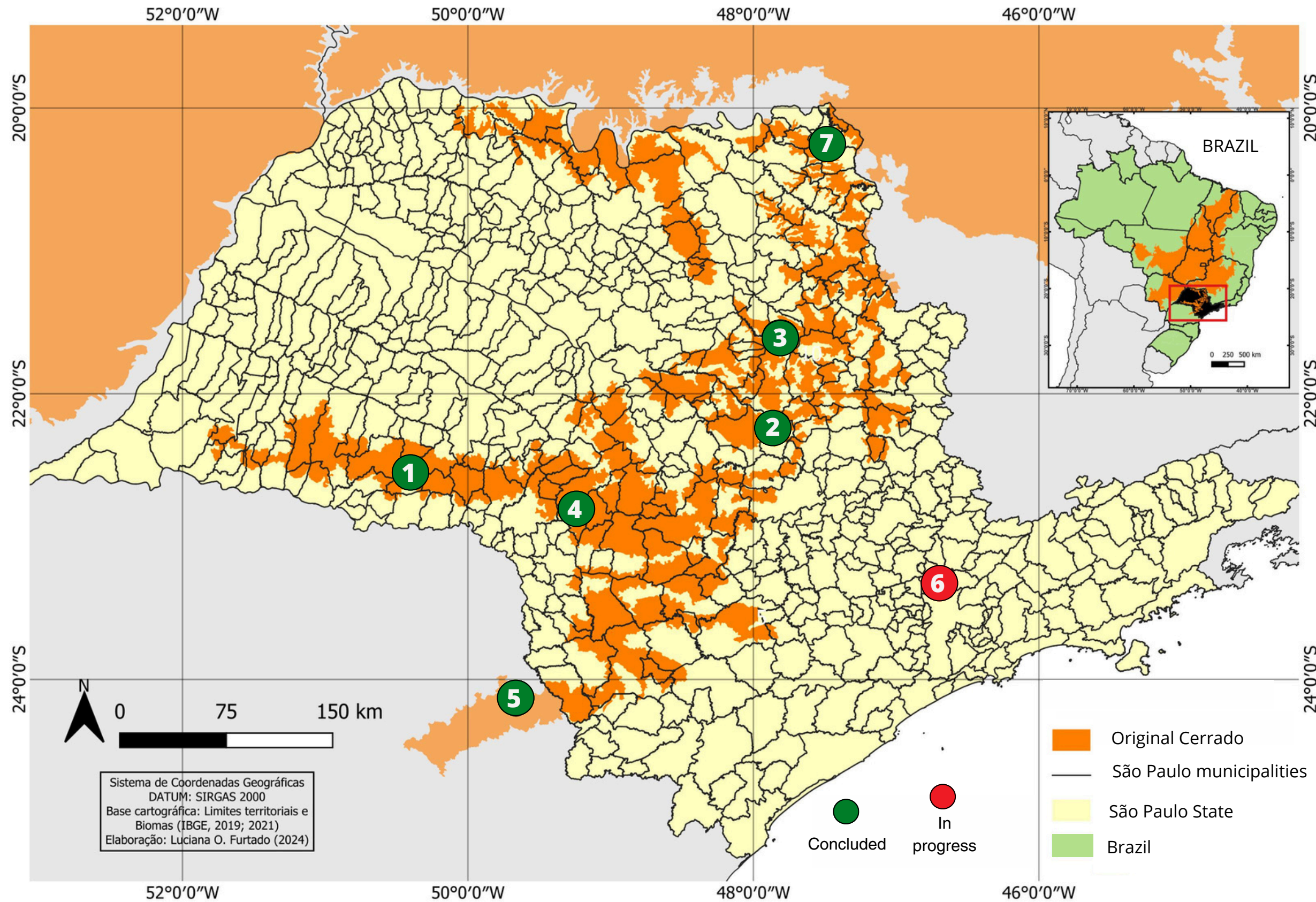
EXPANDING THE RESEARCH

Six additional localities at southeastern Cerrado



Data collection
2023-2025
in progress

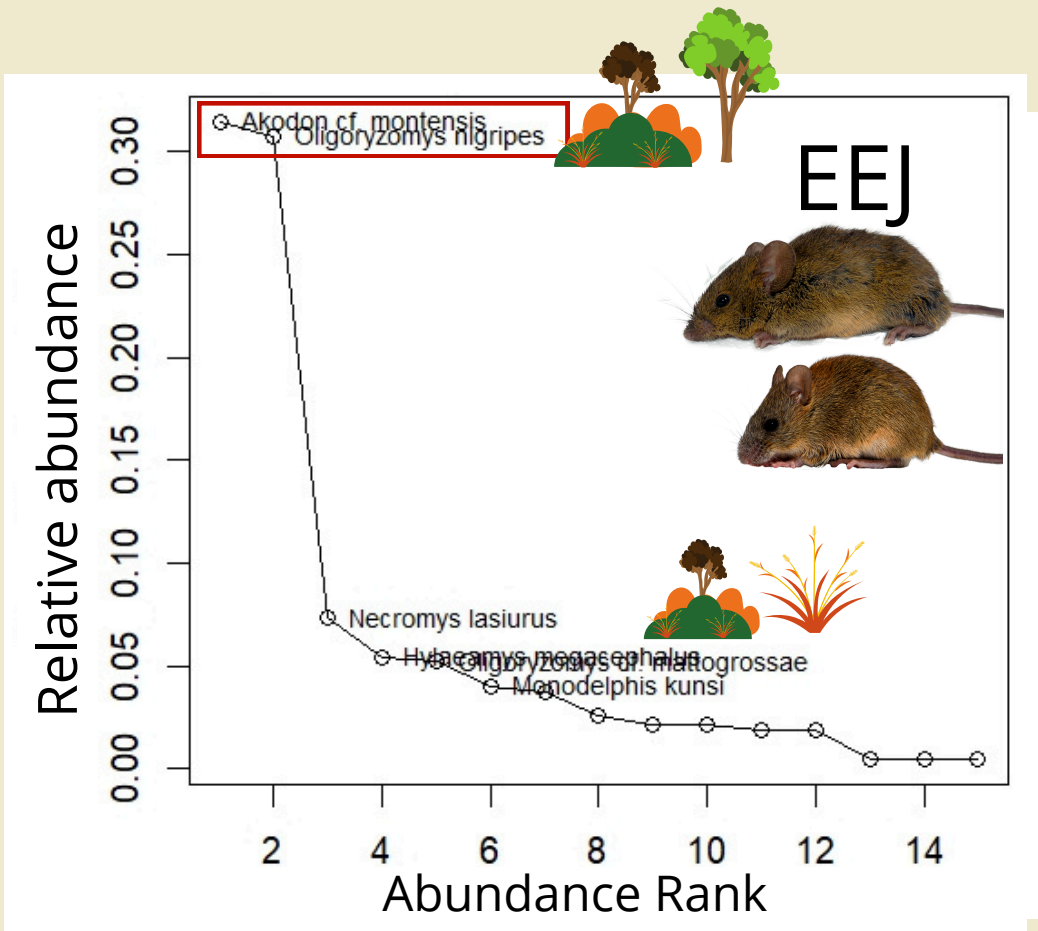
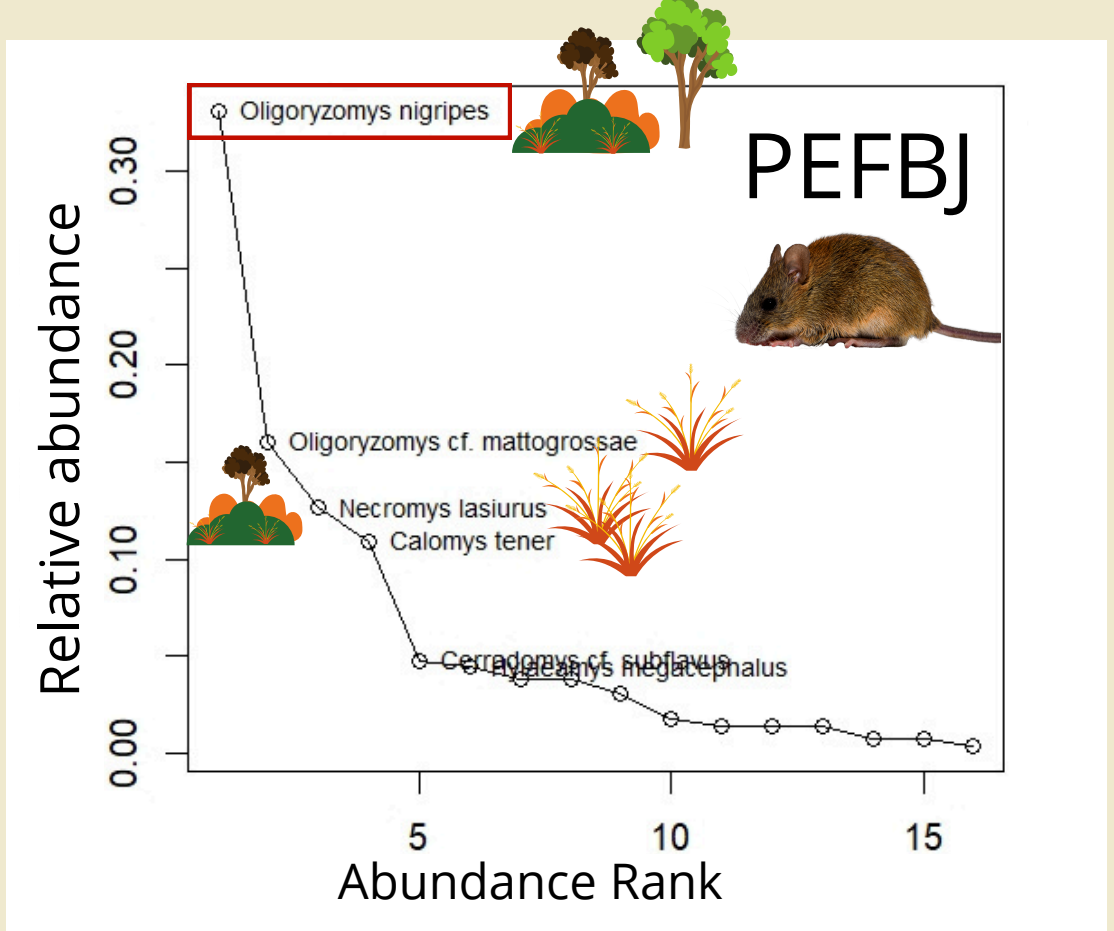
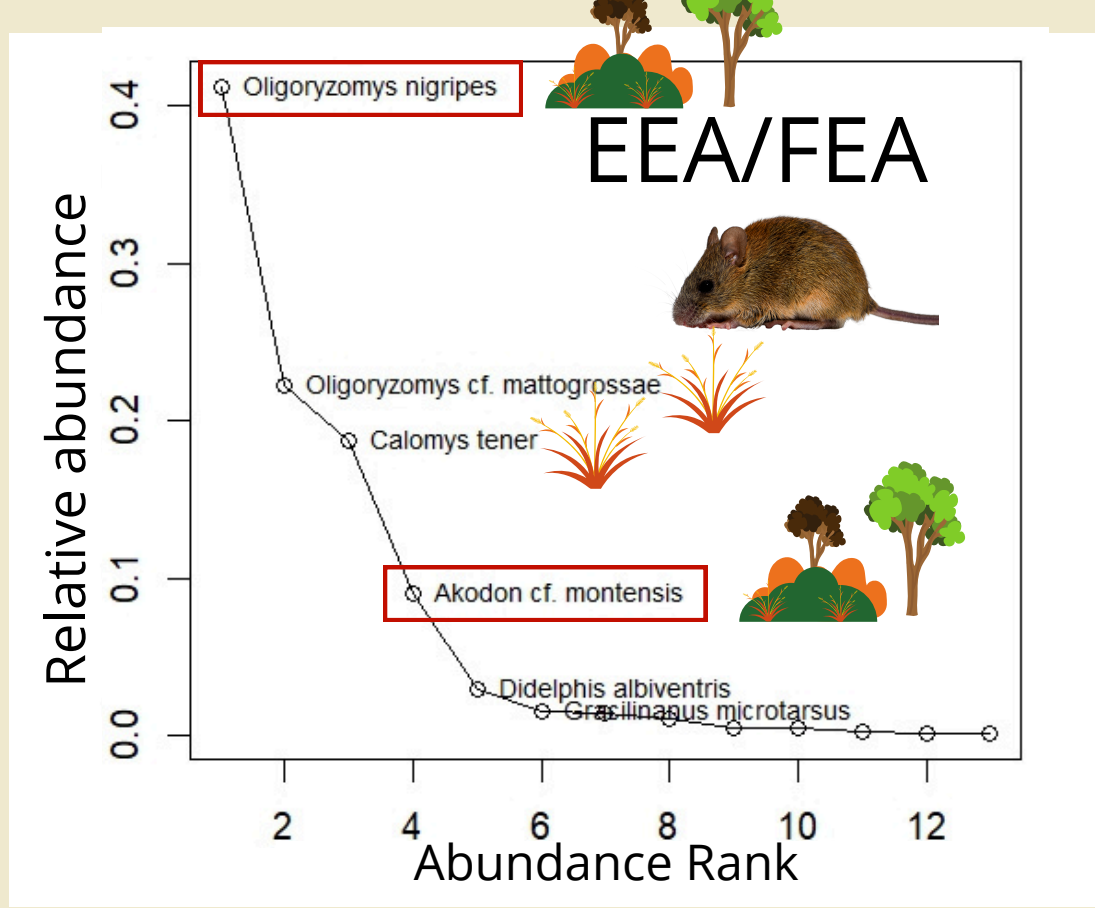
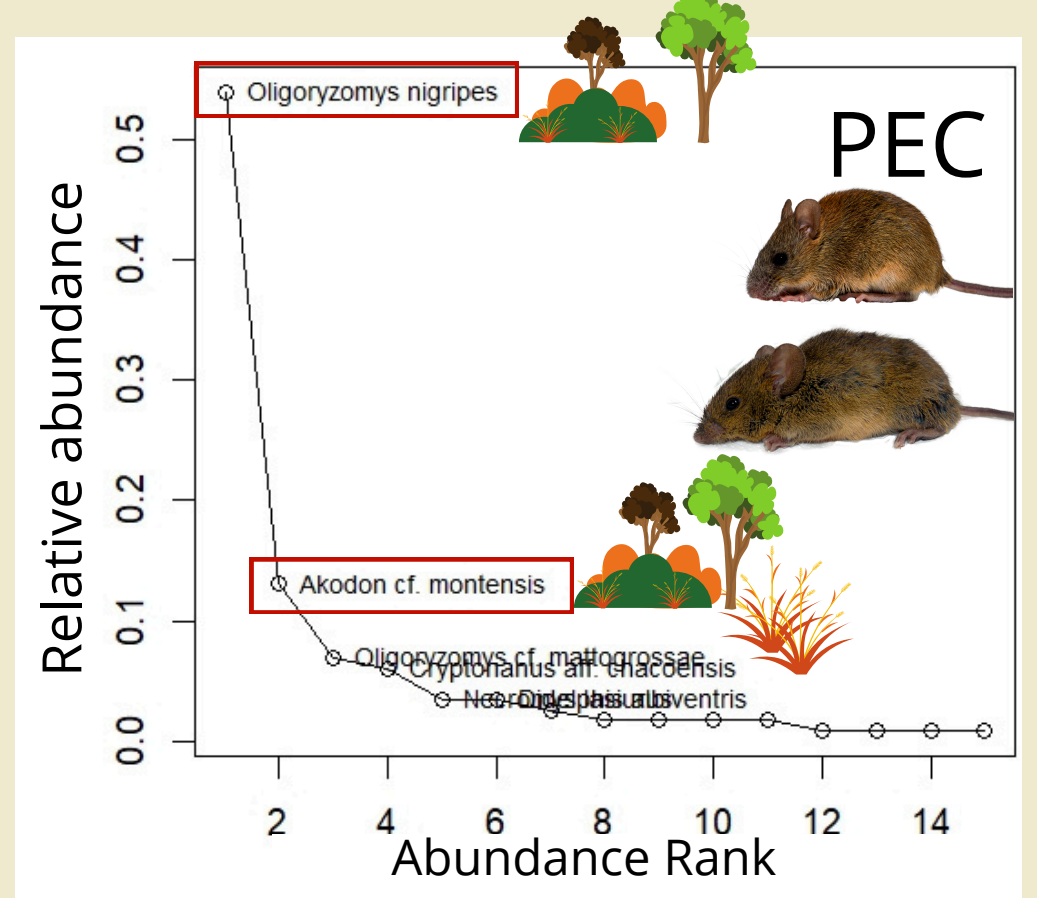
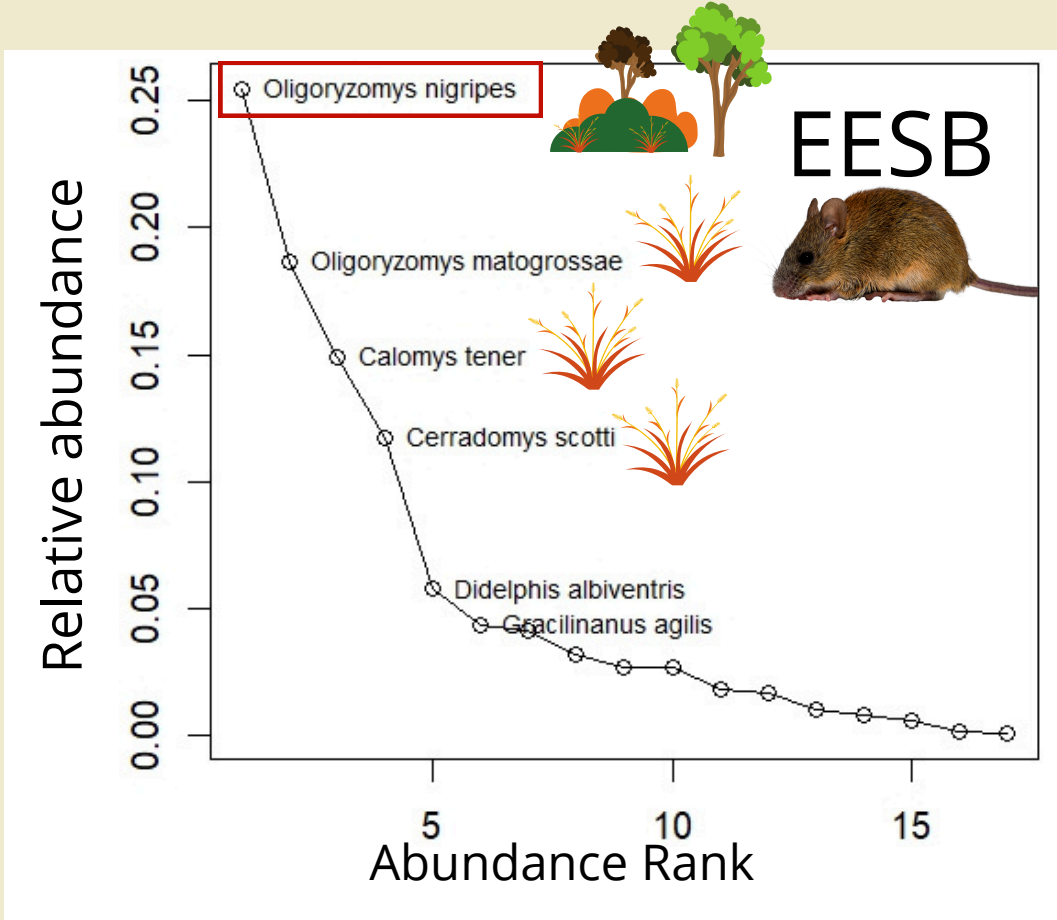
LOCALITIES OF SMALL MAMMAL SURVEY IN SÃO PAULO STATE



SMALL MAMMAL RESPONSES

Woody encroachment

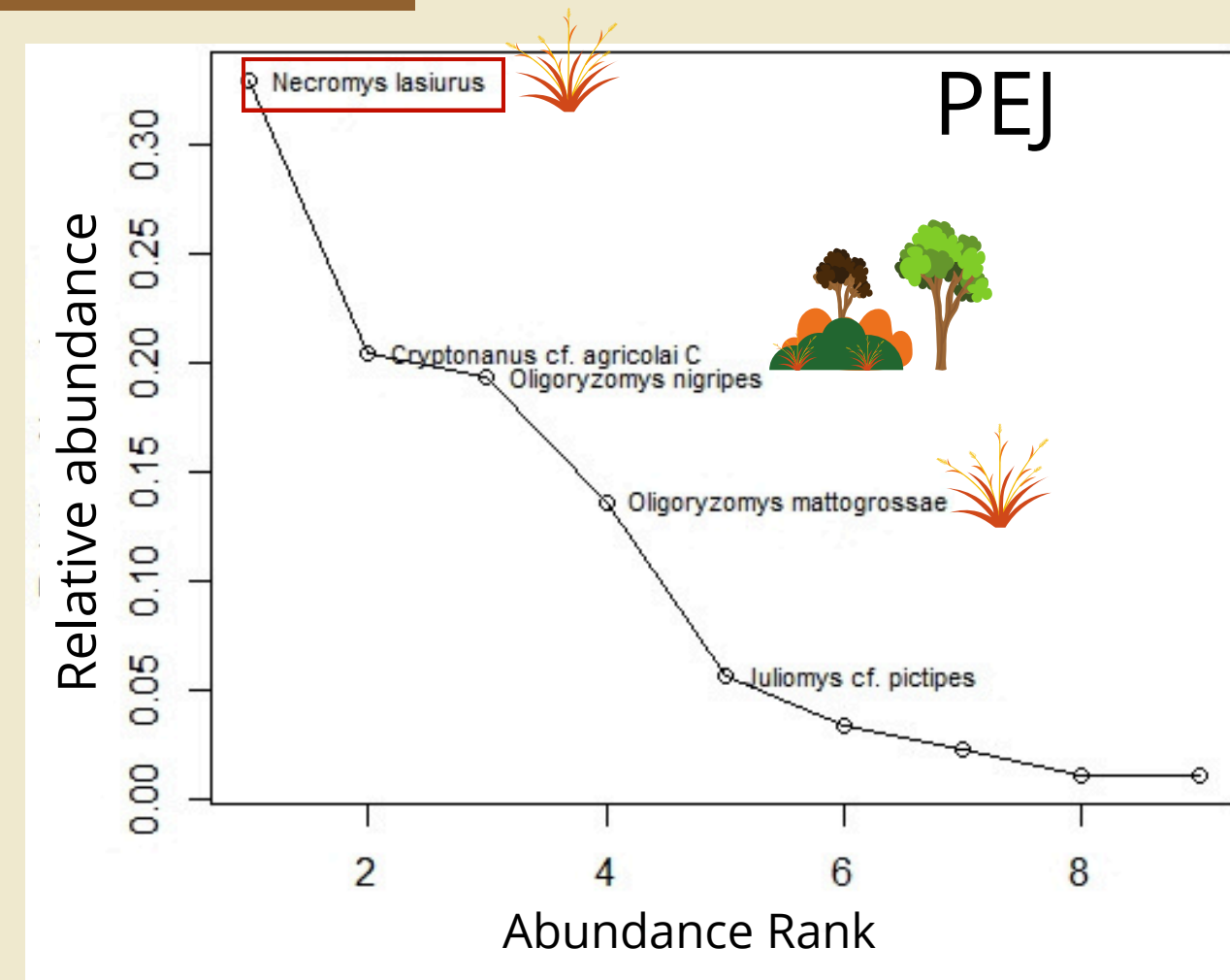
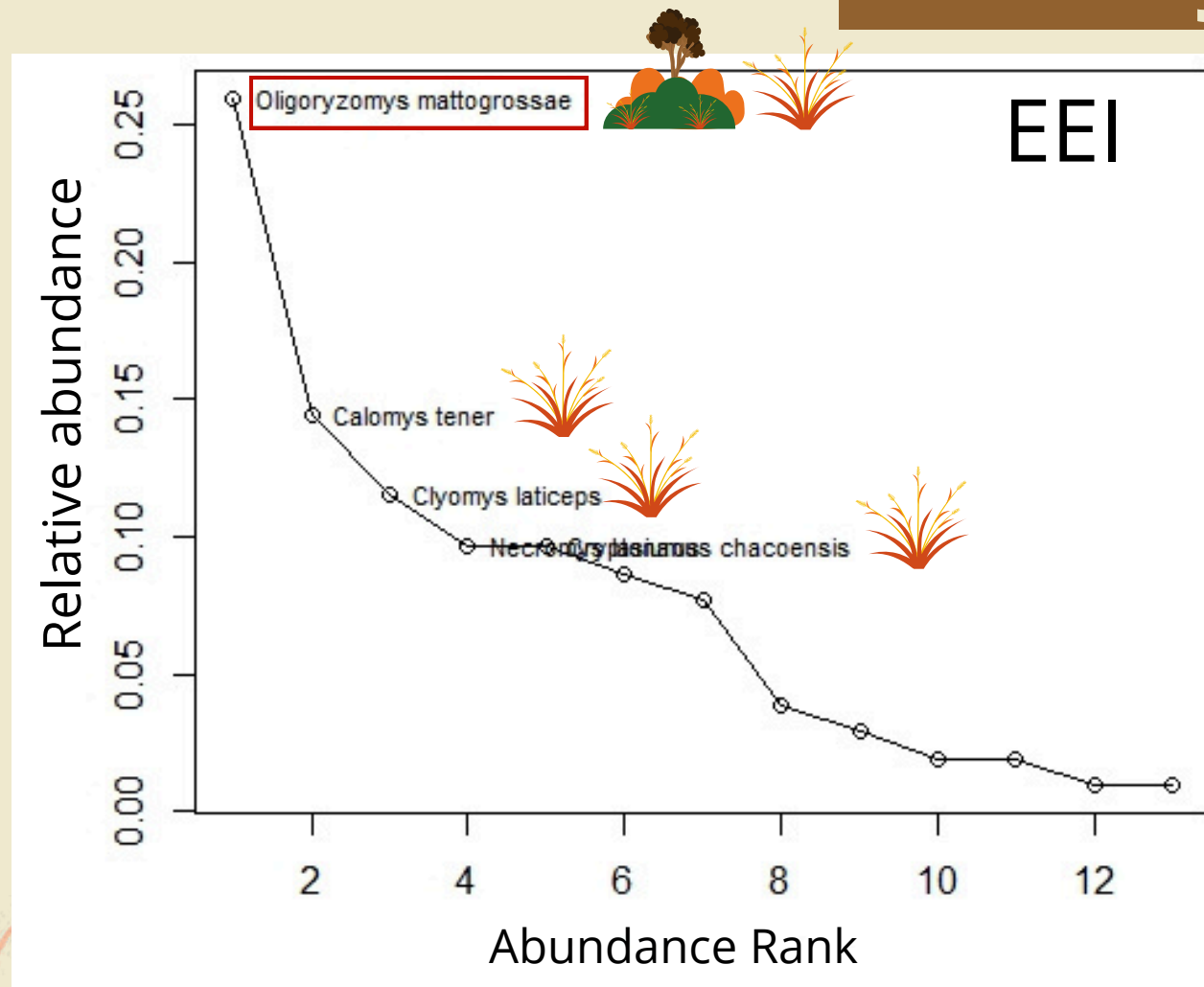
RESULTS



Dominance of forest specialists and lower functional diversity in highly encroached areas



Woody encroachment



Oligoryzomys mattogrossae



Calomys tener



Clyomys laticeps



Necromys lasiurus

Dominance of open-habitat specialists in grassland-dominated localities

FIRE MANAGEMENT AT SBES

Can fire be a solution?
What about small mammals?



Temporal Experiment
Before x After fire

Spatial Experiment
Burned x Unburned plots



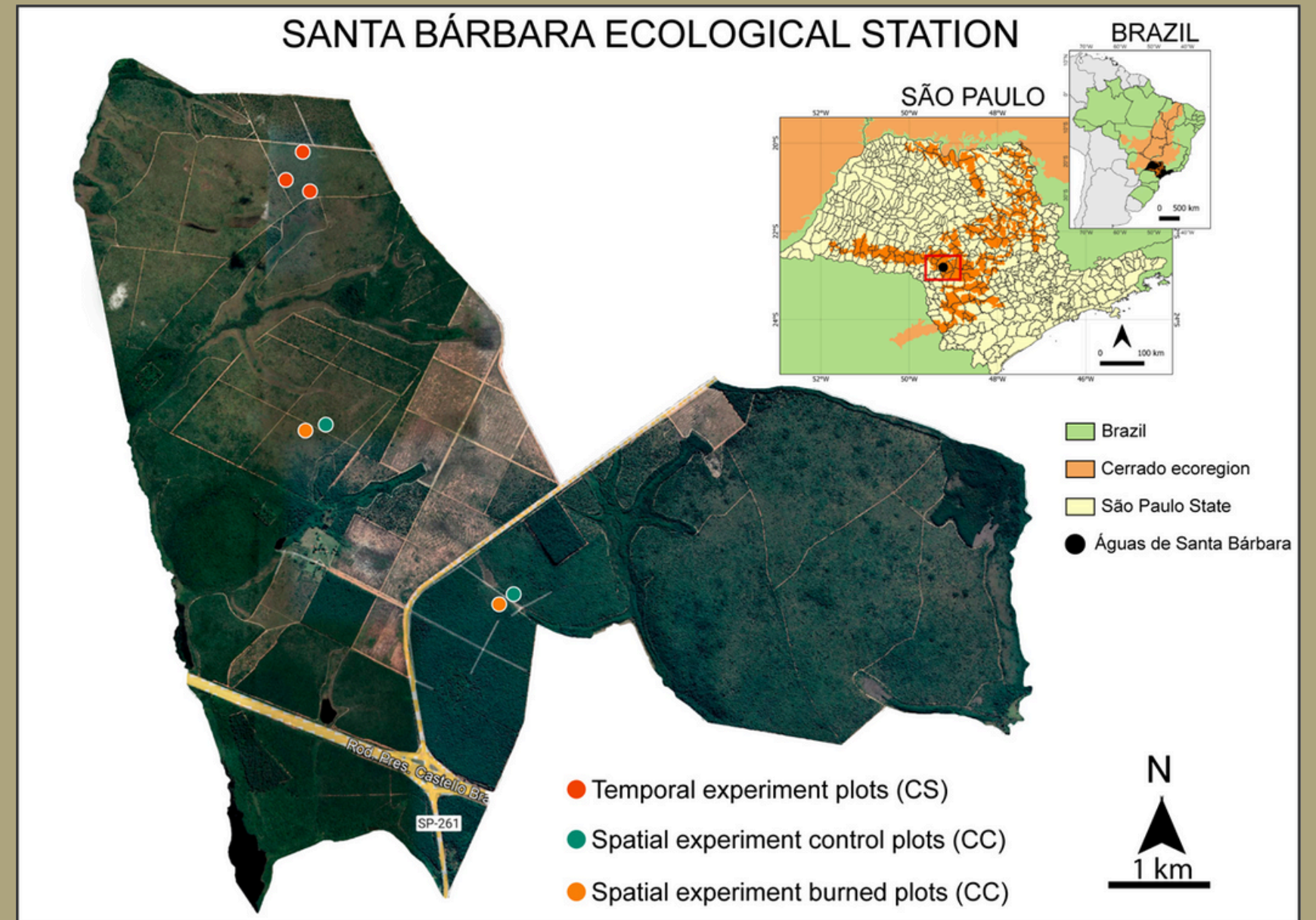
Prescribed burn
July 2018

frontiers
in Forests and Global Change

ORIGINAL RESEARCH
published: 19 February 2020
doi: 10.3389/fgc.2020.00013

No Net Loss of Species Diversity After Prescribed Fires in the Brazilian Savanna

Giselda Durigan^{1,2*}, Natashi A. L. Pilon², Rodolfo C. R. Abreu^{3,4}, William A. Hoffmann², Marcio Martins⁵, Bruno F. Fiorillo⁶, Alexander Z. Antunes⁷, Ana Paula Carmignotto⁸, Jonas B. Maravalhas⁹, Jéssica Vieira⁹ and Heraldo L. Vasconcelos⁹



Kelly et al., 2012; 2016
Griffiths & Brook, 2014
Durigan et al., 2020

Generalized Linear Models (GLM)

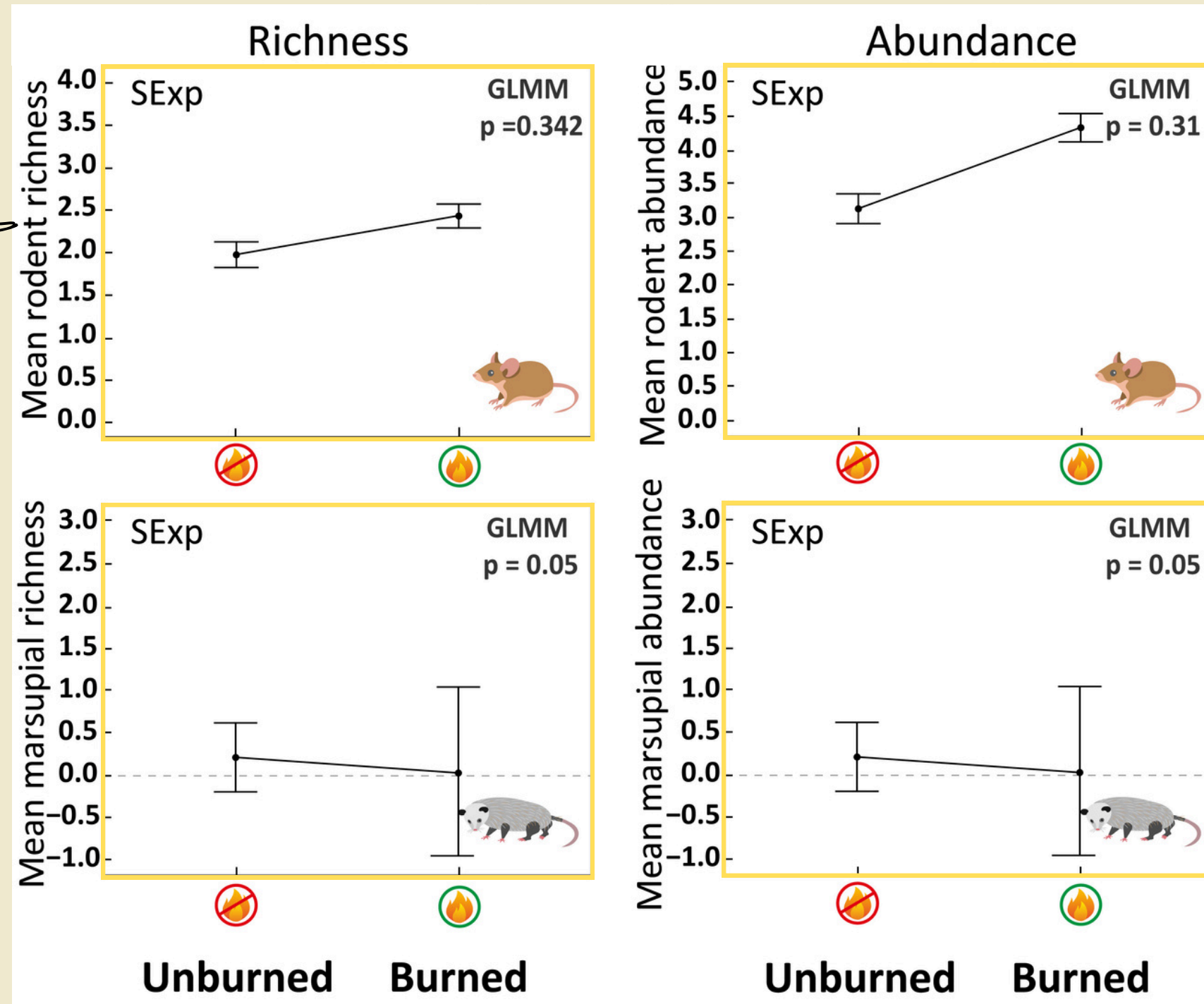
SMALL MAMMAL RESPONSES

Prescribed fire

Spatial Experiment
Burned x Unburned plots



Rodent and marsupial abundance: not affected by prescribed fire



Rodents
Marsupials



SMALL MAMMAL RESPONSES

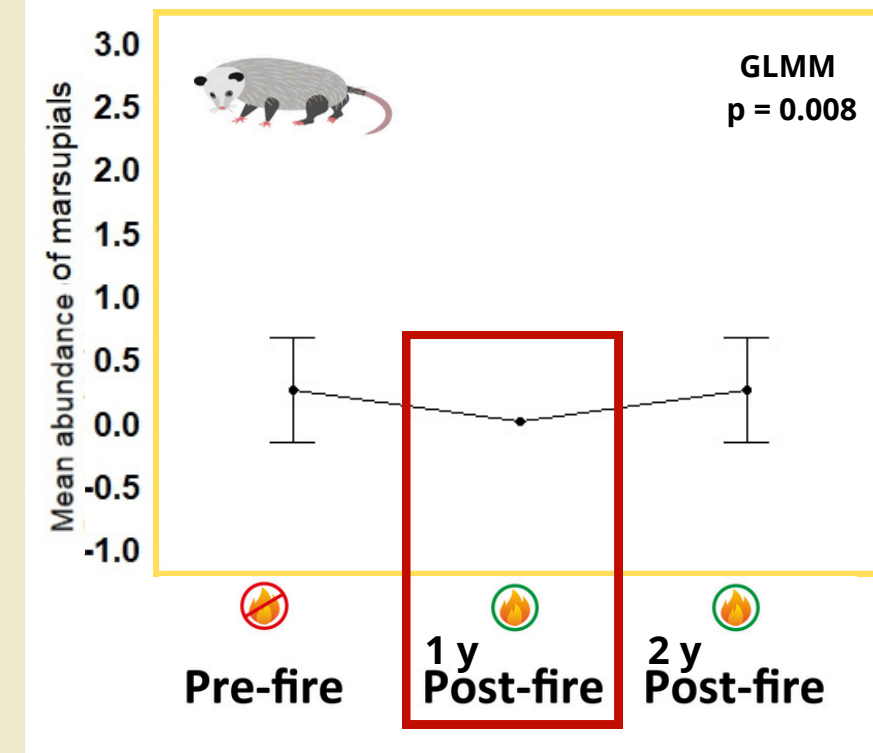
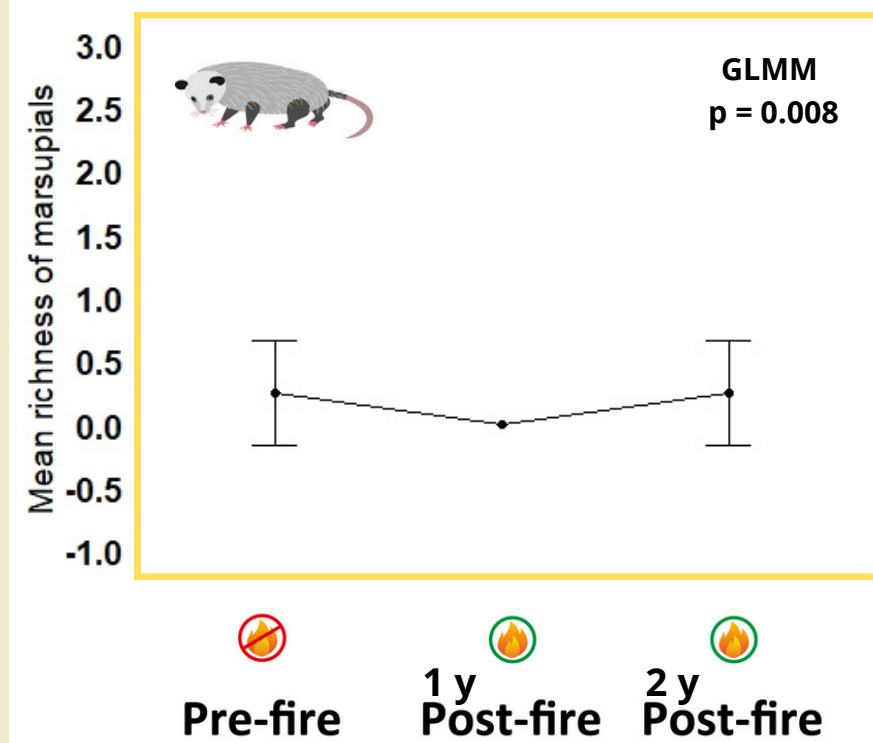
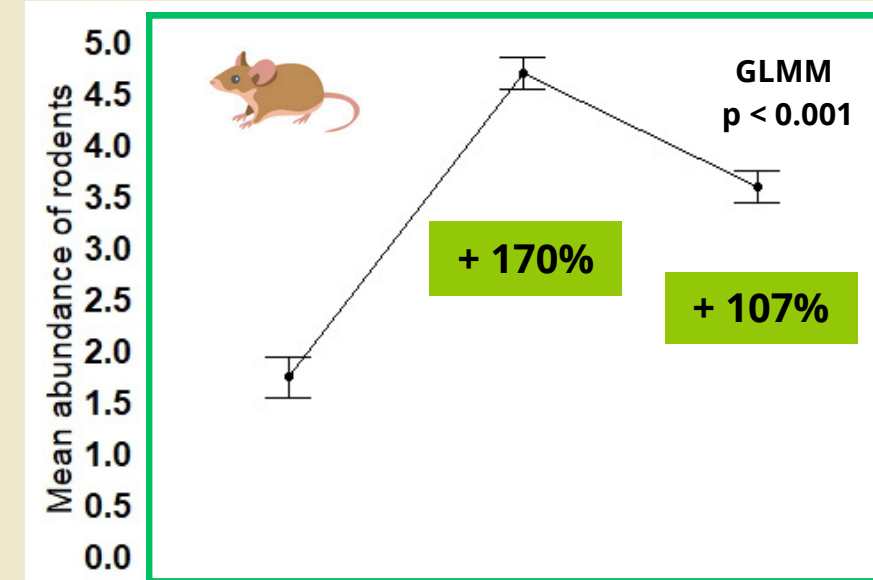
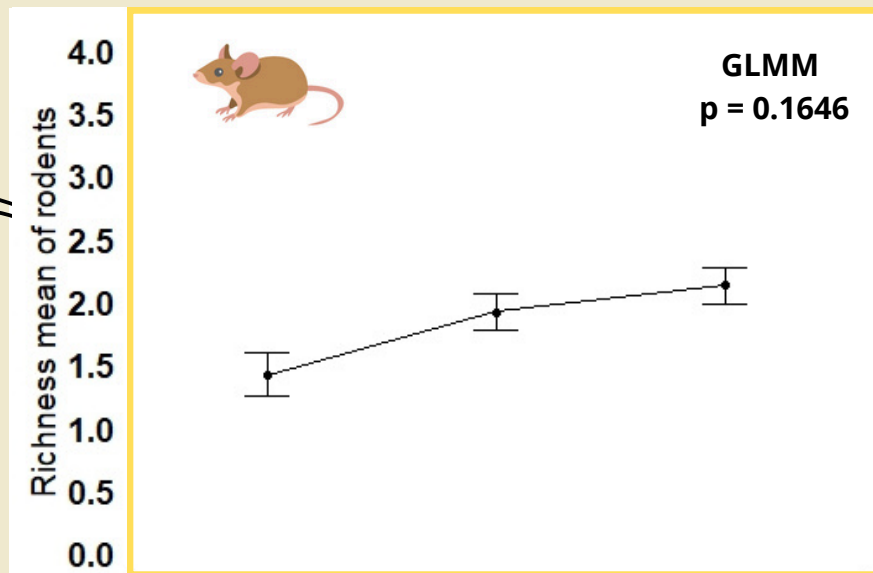
RESULTS

Temporal Experiment
Before x After fire

Prescribed fire

Richness

Abundance



- Positive effect
- No effect
- Negative effect

Rodents increased in abundance post-fire

Marsupials declined in the first year post-fire but recovered afterward

Rodents

Marsupials



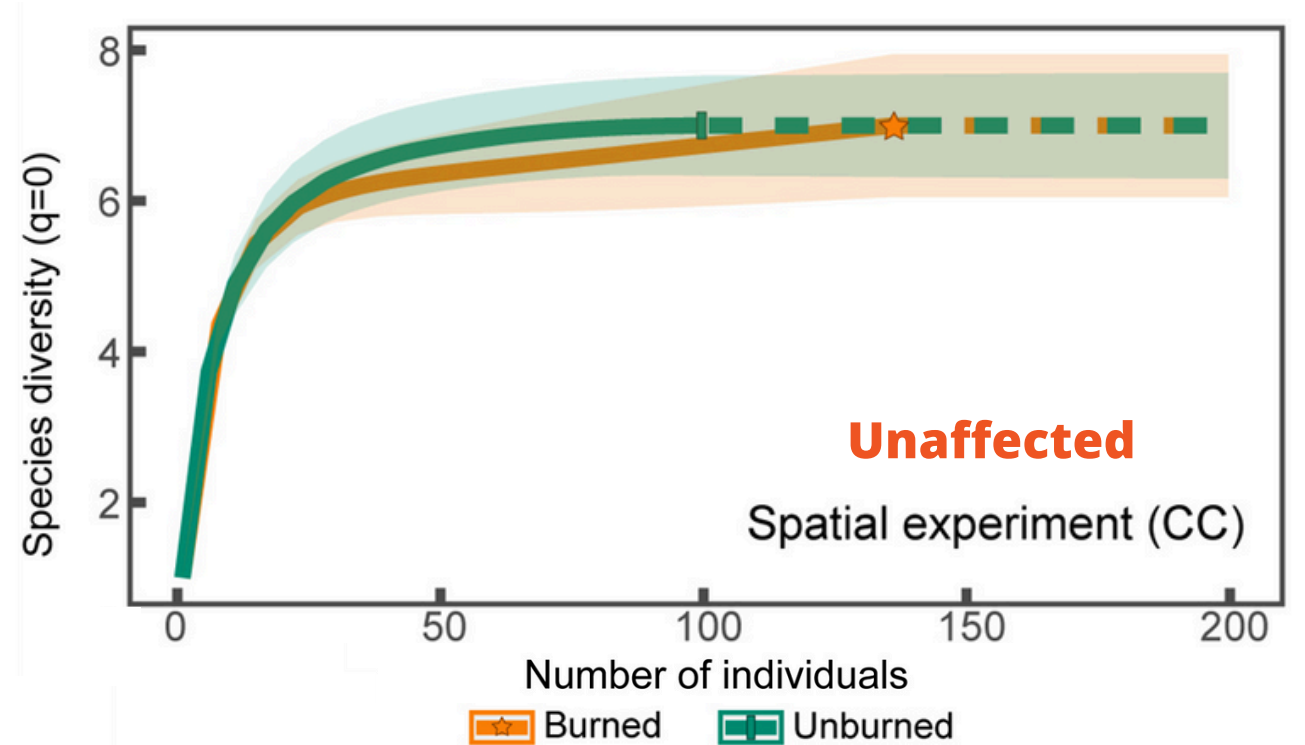
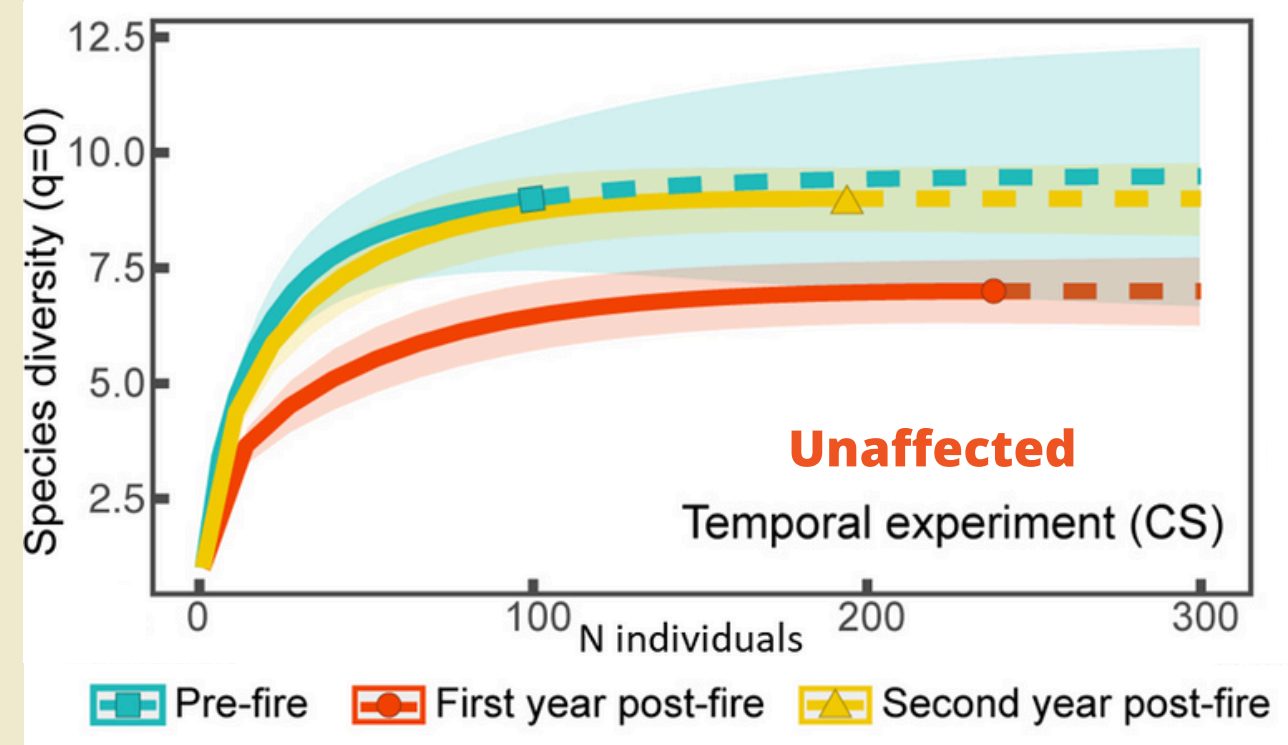
SMALL MAMMAL RESPONSES

RESULTS

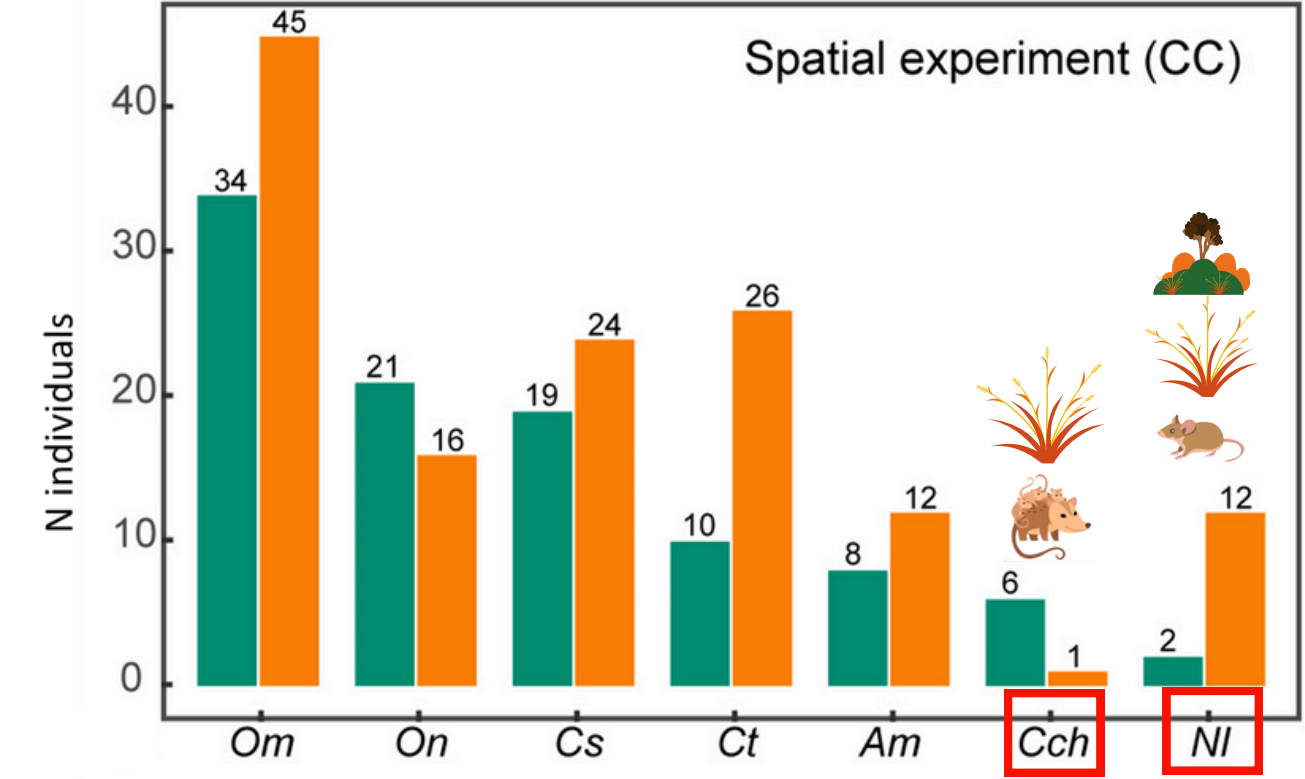
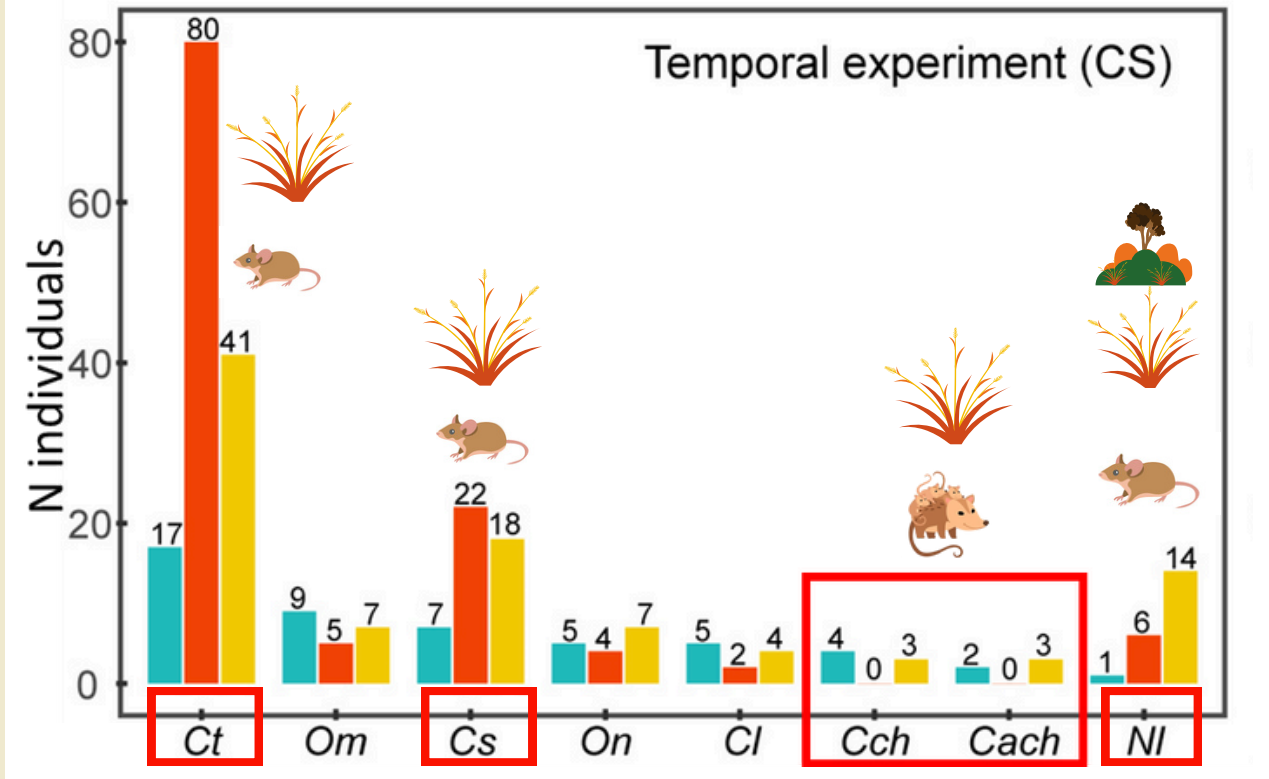
Temporal Experiment
Before x After fire

Spatial Experiment
Burned x Unburned plots

Richness



Abundance



Fire favored open-habitat rodents



8 species

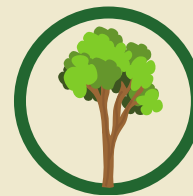
7 species

ALL TOGETHER: HOW SMALL MAMMALS RESPONDED TO ENCROACHMENT AND PRESCRIBED FIRE

Winners and losers:
Species-specific responses to fire and encroachment shape the community







Understanding these responses requires knowledge of their habitat use

WOODY ENCROACHMENT EFFECT



EFFECT



	AFFECTED BY FIRE AND WOODY ENCROACHMENT	AFFECTED ONLY BY WOODY ENCROACHMENT
	 <i>Necromys lasiurus</i> A- F+ <i>Cerradomys scotti</i>	 <i>Didelphis albiventris</i> * A+
	 A- F- <i>Cryptonanus chacoensis</i>	 A+ F <i>Oligoryzomys nigripes</i>
	AFFECTED ONLY BY FIRE  <i>Calomys tener</i> A F+	UNAFFECTED  <i>Oligoryzomys mattogrossae</i> <i>Akodon montensis</i> ** <i>Clyomys laticeps</i> **



PRESCRIBED FIRE EFFECT



Woody encroachment favored forest-dwellers abundance at the expense of open-habitat specialists

Prescribed fire benefited open-habitat specialists, particularly rodents that are vulnerable to woody encroachment

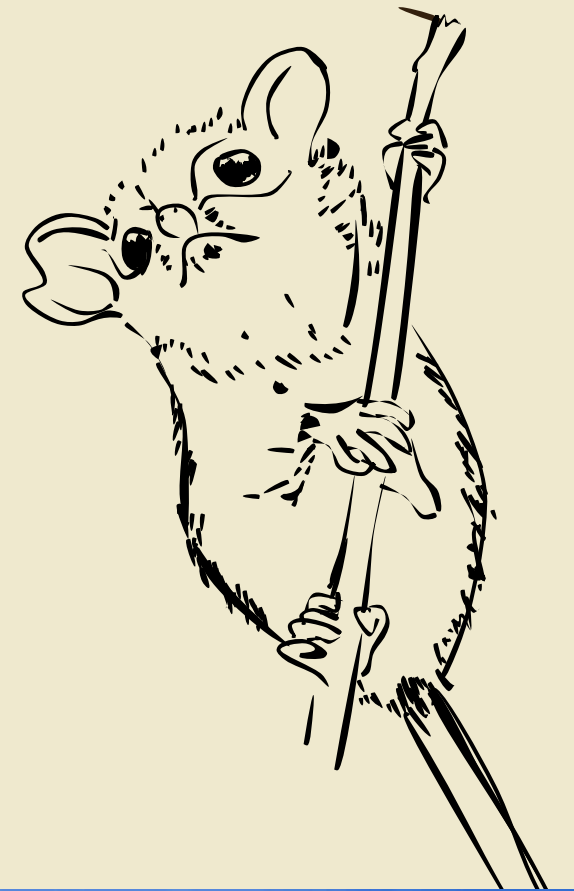
CONCLUSIONS



Prescribed fire is an effective management tool for mitigating the impacts of woody encroachment on small mammals in the Cerrado



A mosaic of burned and unburned habitats is crucial to mitigate woody encroachment and conserve open-habitat specialists



Thank you, team!





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Thank you!

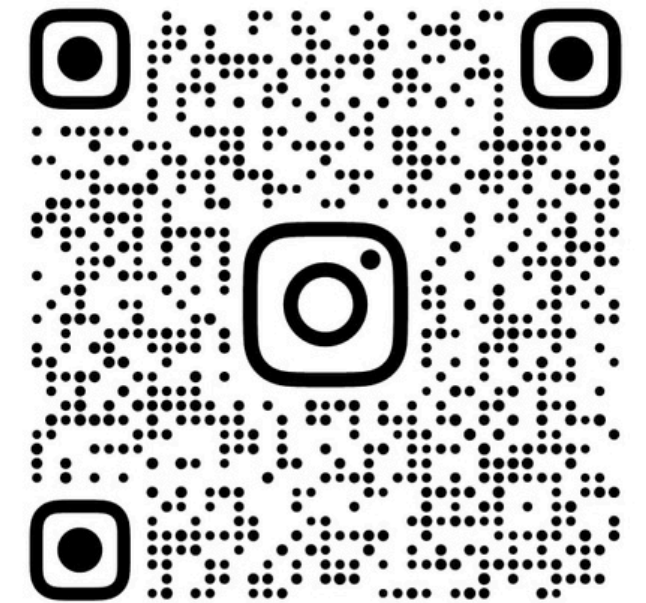


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LASSMA

LABORATORY OF MAMMALS
SYSTEMATIC - UFSCAR



@LASISMA_UFSCAR

