Tropical Forest Restoration as a Nature-based Solution: Lessons, Challenges and Opportunities

Prof. Ricardo Viani

(Federal University of São Carlos)

Institutional support:

Ecosystem restoration is a global priority

UNITED NATIONS DECADE ON ECOSYSTEM RESTORATION 2021-2030

BONN CHALLENGE

PACTO PELA RESTAURAÇÃO DA MATA ATLANTICA

GOVERNO FEDERAL BRASIL UNIÃO E RECONSTRUÇÃO

12 million hectares up to 2030

Forest restoration contributes to climate change mitigation, but cannot replace rapid emissions cuts

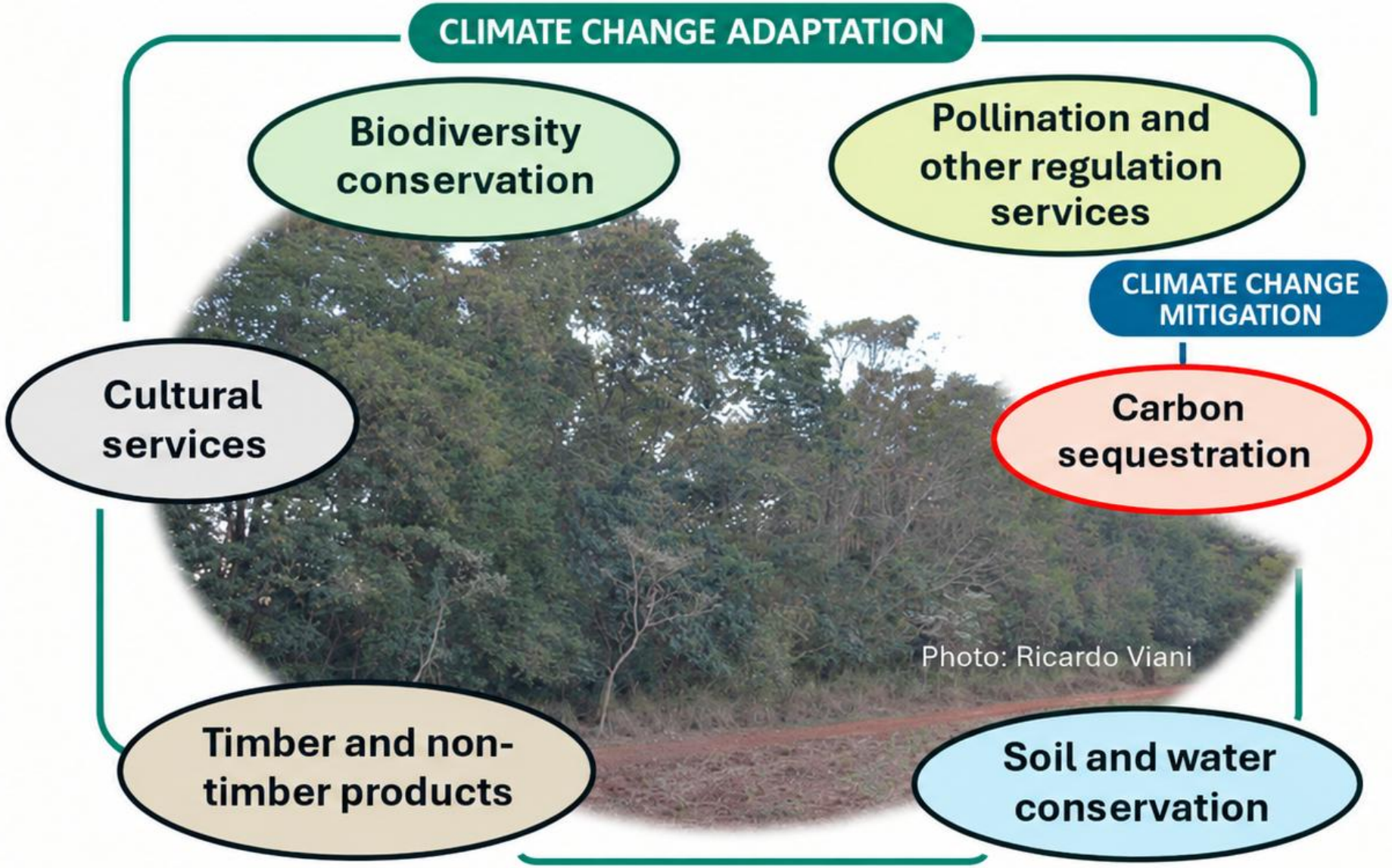
Global potential of reforestation

- **195 Mha**
- **2,225 Tg CO_2e per year**
- **3–5% of total emissions**

nature communications

Addressing critiques refines global estimates of reforestation potential for climate change mitigation

Forest restoration can generate multiple benefits

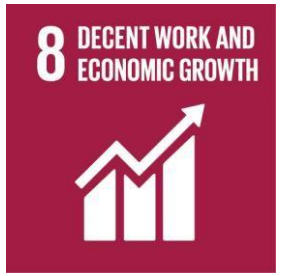


















Brazil is a global leader in tropical forest restoration research

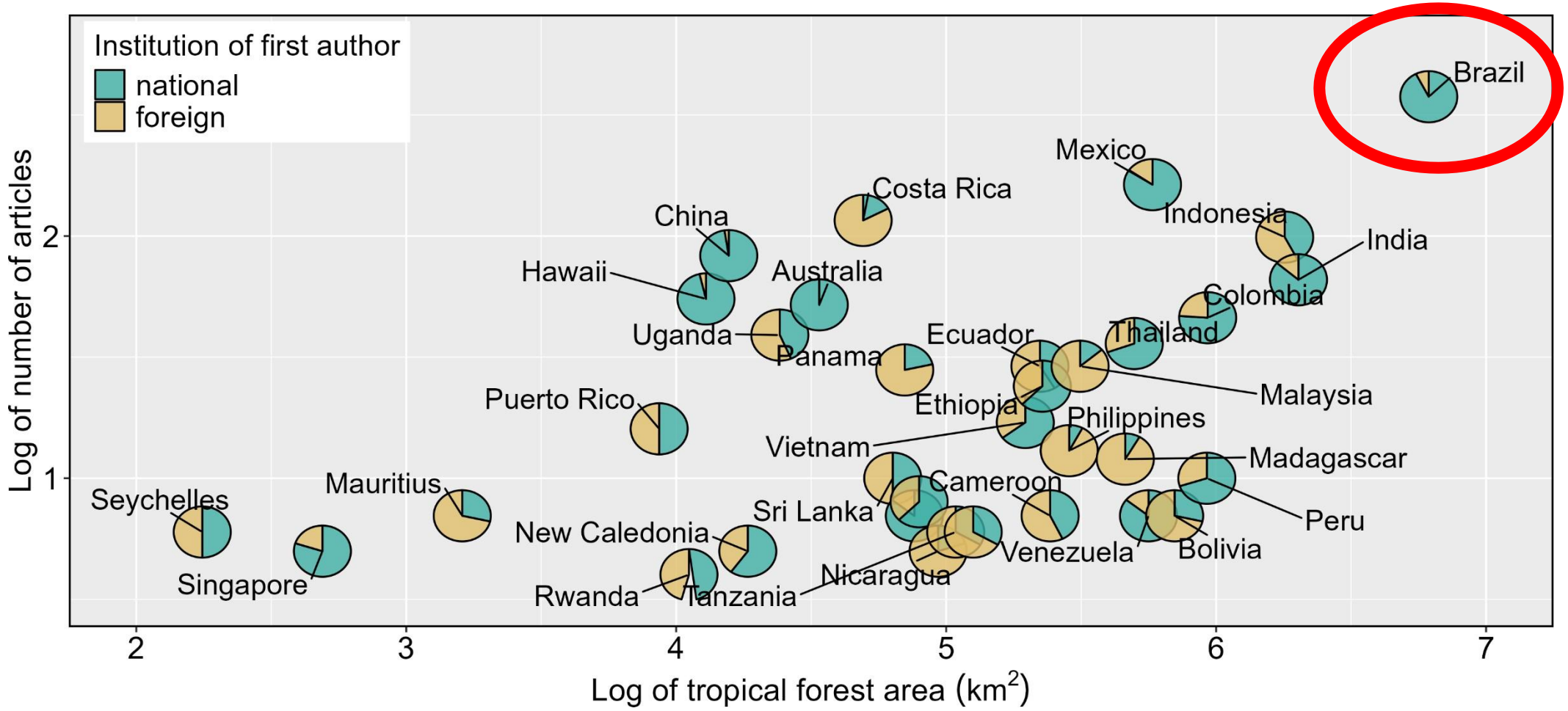
2025

RESTORATION ECOLOGY
The Journal of the Society for Ecological Restoration

RESEARCH ARTICLE

A global analysis of strengths and weaknesses in our scientific knowledge of tropical forest restoration

Ricardo A. G. Viani[1,2], J. Leighton Reid[3]



Species selection shapes outcomes of forest restoration



Cedrela fissilis



Solanum granulosoleprosum





Photos: Ricardo Viani

Two-year-old trees planted on the same day at the same site

Research highlights: species matter in forest restoration

Research Letters

Animal-dispersed pioneer trees enhance the early regeneration in Atlantic Forest restoration plantations

ORIGINAL ARTICLE

Non-continuous reproductive phenology of animal-dispersed species in young forest restoration plantings

RESEARCH ARTICLE

Selection of shade trees in forest restoration plantings should not be based on crown tree architecture alone

Forest Science, 2024, **70**, 397–404
https://doi.org/10.1093/forsci/fxae022

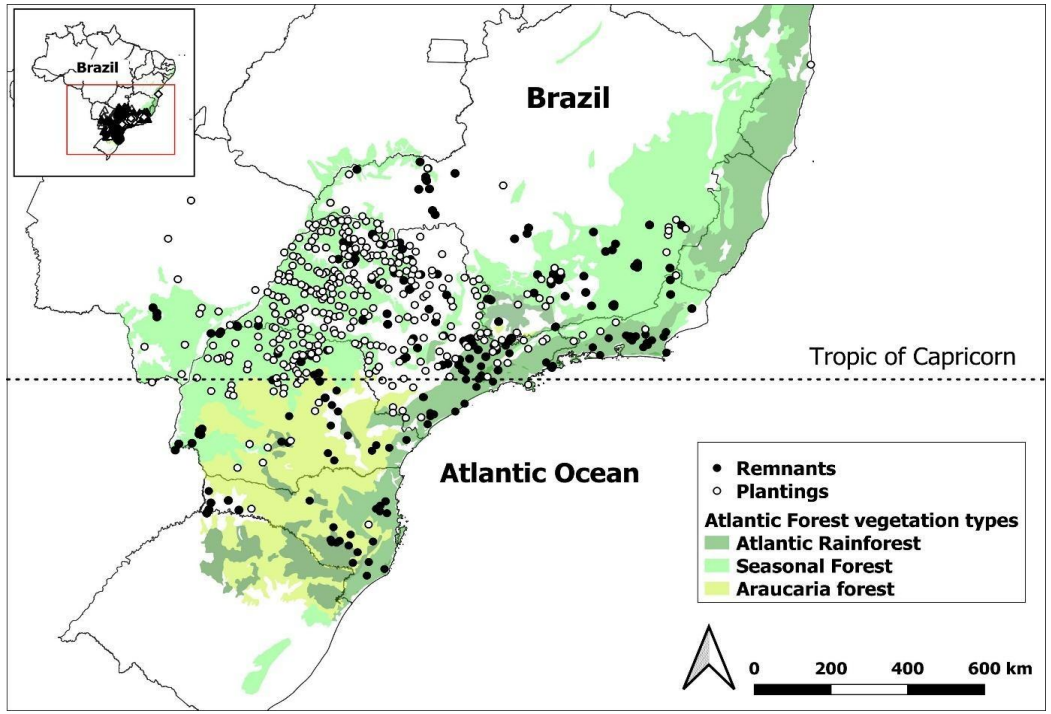
Tropical Timber Species Grow Faster in Full Sun Than in the Understory of Restoration Plantings



Photo: Ricardo Viani

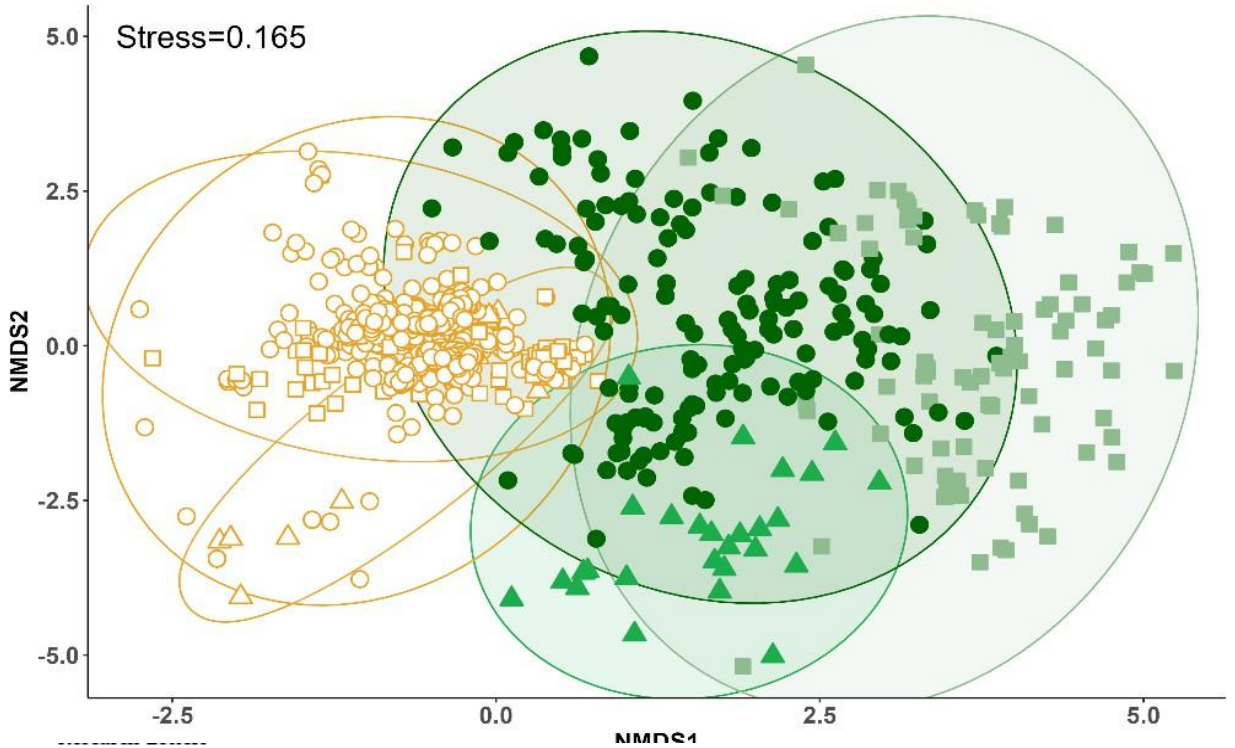
Restoration plantings (orange)

- ✓ 423 tree species (< 8% of the total), prioritizing fast-growing trees
- ✓ Late-successional, animal-dispersed, threatened species are underrepresented
- ✓ Similar small set of species across the Atlantic Forest



Restoration plantings in the Atlantic Forest use a small, biased, and homogeneous set of tree species

Crislaine de Almeida [a,*], J. Leighton Reid [b], Renato A. Ferreira de Lima [c], Luis Fernando Guedes Pinto [d], Ricardo Augusto Gorne Viani [e]



High-diversity Atlantic Forest restoration plantings fail to represent local floras

Perspectives in Ecology and Conservation
Volume 23, Issue 1, January–March 2025, Pages 6-11

Crislaine de Almeida [a], J. Leighton Reid [b], Renato A. Ferreira de Lima [c], Luis Fernando Guedes Pinto [d], Ricardo Augusto Gorne Viani [e,*]

A synthesis of recovery of biomass and diversity in Cerrado restoration

(Simões et al., in prep.)

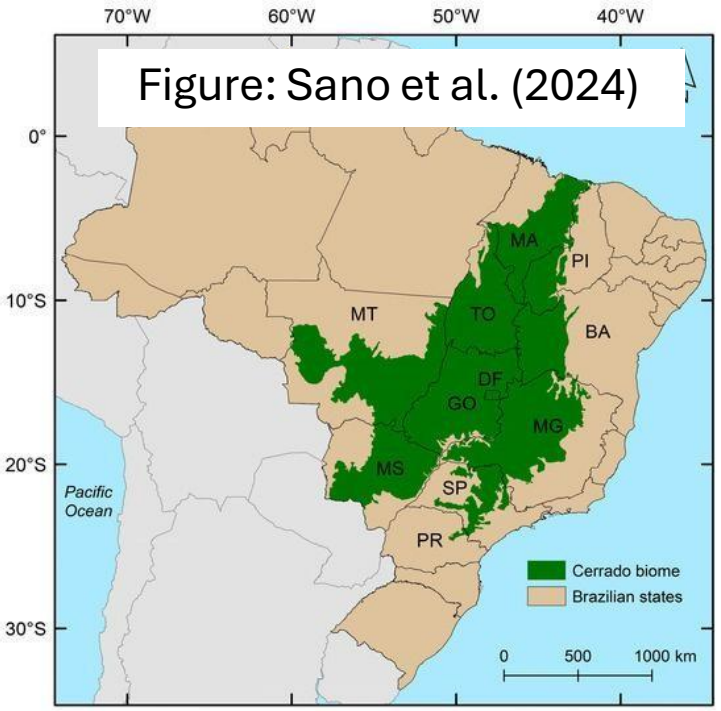
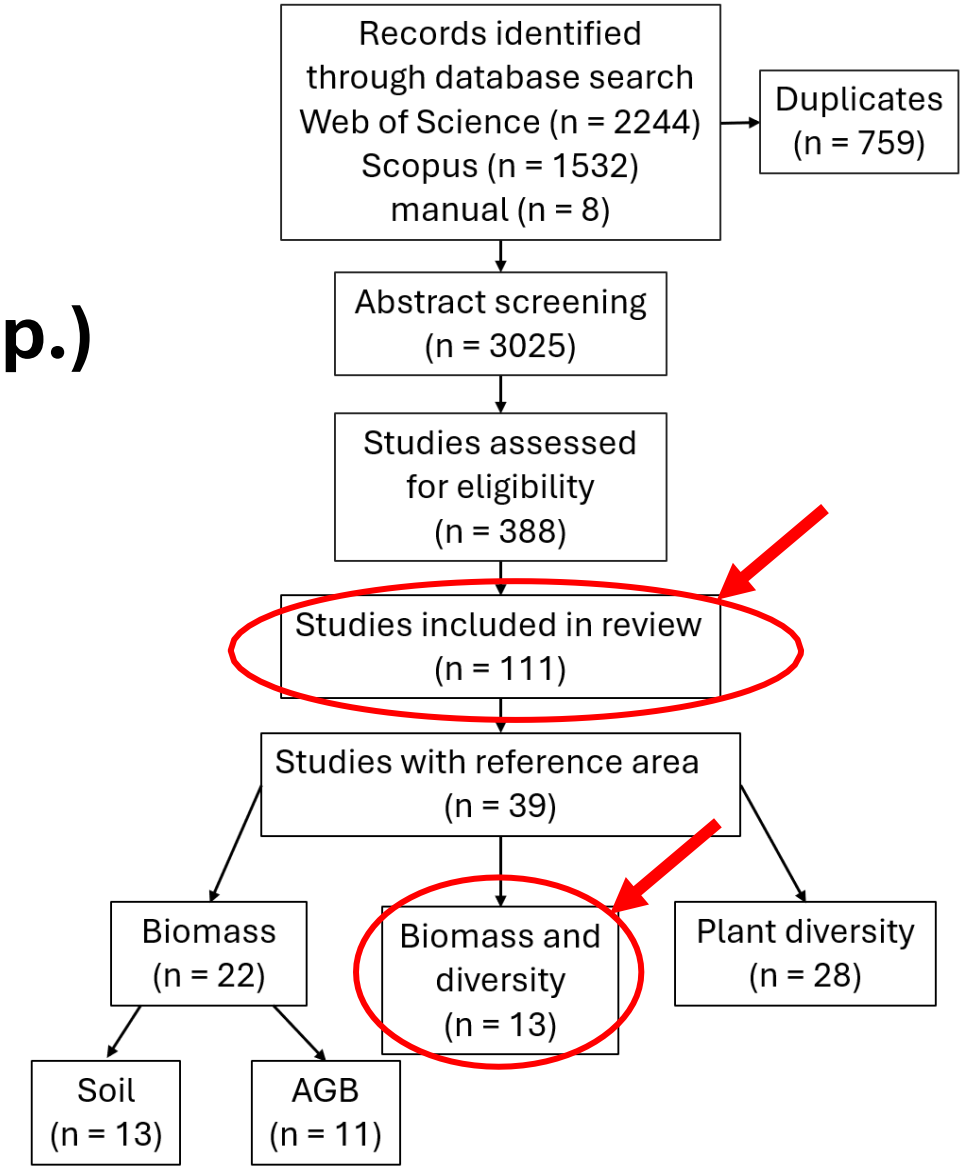


Figure: Sano et al. (2024)



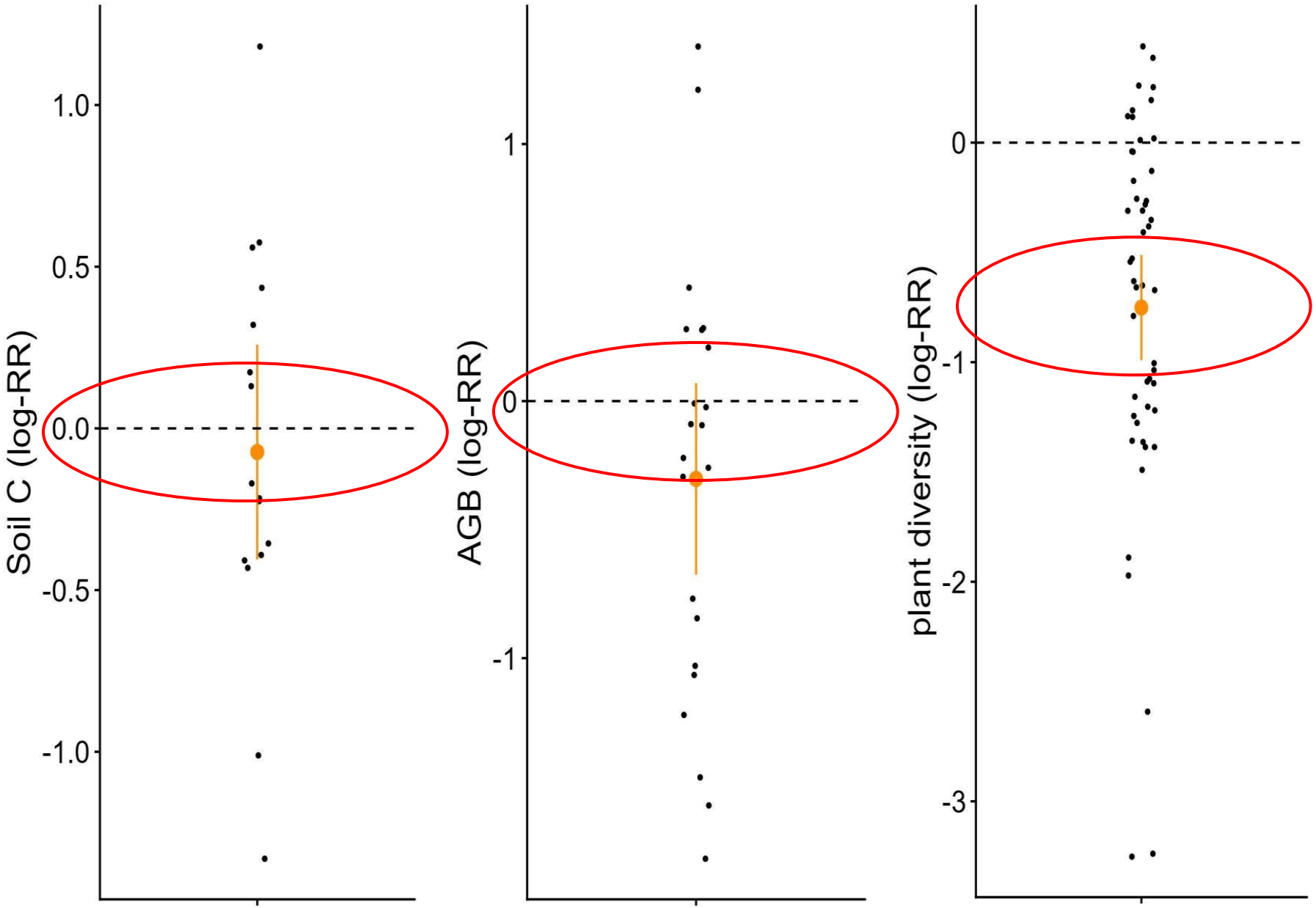






Photos: Ricardo Viani

Carbon and biomass recover more readily than plant diversity



Simões *et al.* (in prep.): A synthesis of recovery of biomass and diversity in Cerrado restoration

Laspef

UFSCar

WAGENINGEN UNIVERSITY & RESEARCH

FAPESP SÃO PAULO RESEARCH FOUNDATION

Carbon Countdown

CCARBON
CENTER FOR CARBON RESEARCH IN TROPICAL AGRICULTURE
UNIVERSITY OF SÃO PAULO

A baseline for soil and vegetation carbon stocks in Brazil

- 1,000 plots (50 × 50 m)
- Carbon and biodiversity surveys in native vegetation and restoration
- Remote sensing: drones and LiDAR
- Destructive sampling for biomass calibration

Spatial modelling of carbon stocks



Photo: Ricardo Viani

Making forest restoration financially viable at scale

Finding the money for tropical forest restoration

P.H.S. Brancalion, R.A.G. Viani, B.B.N. Strassburg and R.R. Rodrigues Unasylva (2013)

MOMBAK

re.green

“The challenge for advocates of forest restoration is to make it financially viable”





Photos: Ricardo Viani



Making forest restoration financially viable at scale

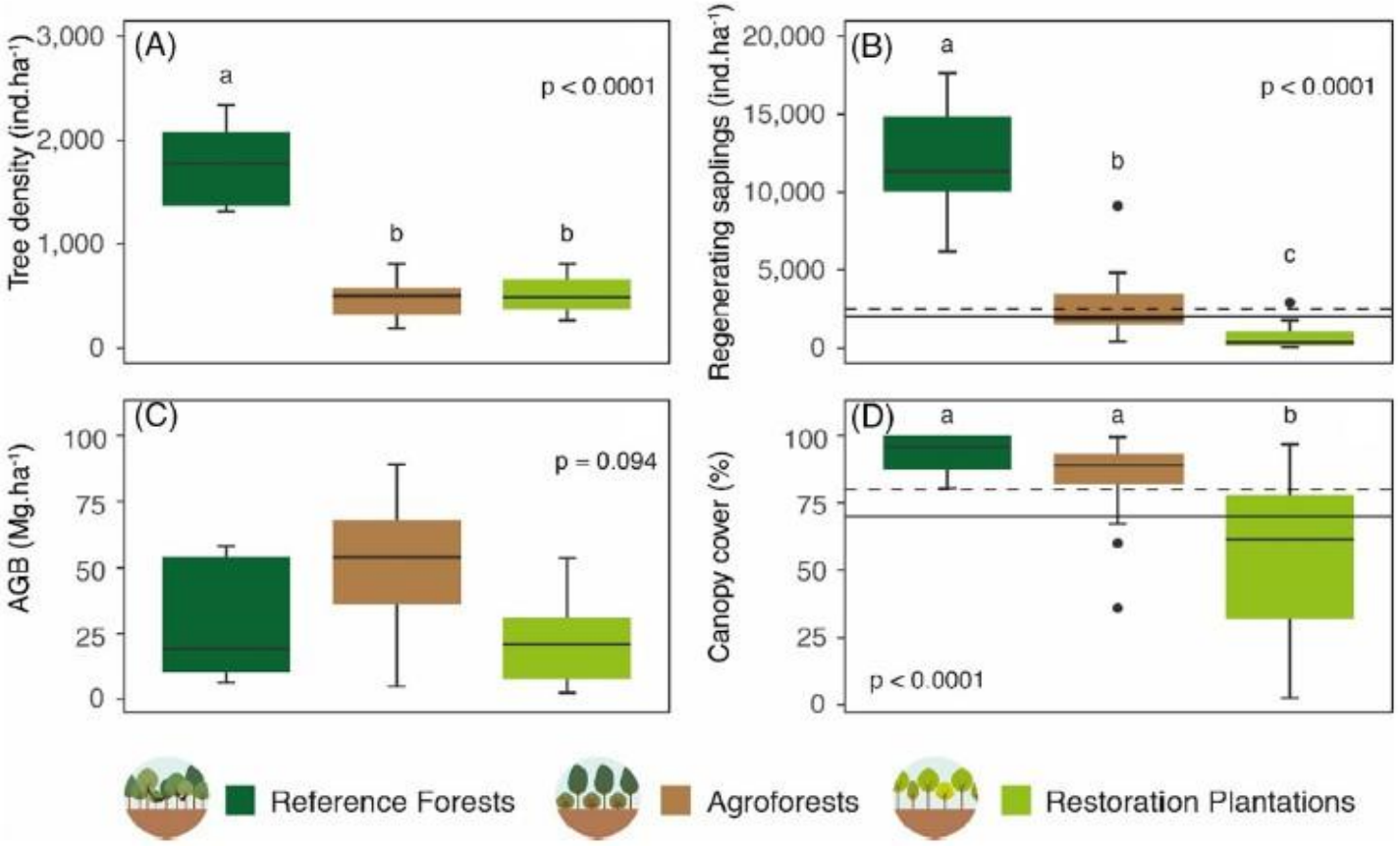
Coffee agroforestry systems can have similar or better ecological outcomes than traditional restoration plantings

RESTORATION ECOLOGY
The Journal of the Society for Ecological Restoration
SER

RESEARCH ARTICLE

Ecological outcomes of agroforests and restoration 15 years after planting

Carolina Giudice Badari[1], Luis Eduardo Bernardini[1], Danilo R. A. de Almeida[1], Pedro H. S. Brancalion[1], Ricardo G. César[2], Victoria Gutierrez[2], Robin L. Chazdon[3,4], Haroldo B. Gomes[5], Ricardo A. G. Viani[6,7]





PP&D-SEN: Research and Development Program for Native Trees Silviculture

BRAZILIAN COALITION ON CLIMATE, FORESTS AND AGRICULTURE

SILVICULTURA DE NATIVAS
PP&D-SEN

- ✓ Atlantic Forest and Amazon
- ✓ 20 long-term experimental sites for management and breeding
- ✓ 30 priority tree species (15 from each biome)
- ✓ **Current funding:** Brazilian Development Bank (BNDES) and Bezos Earth Fund

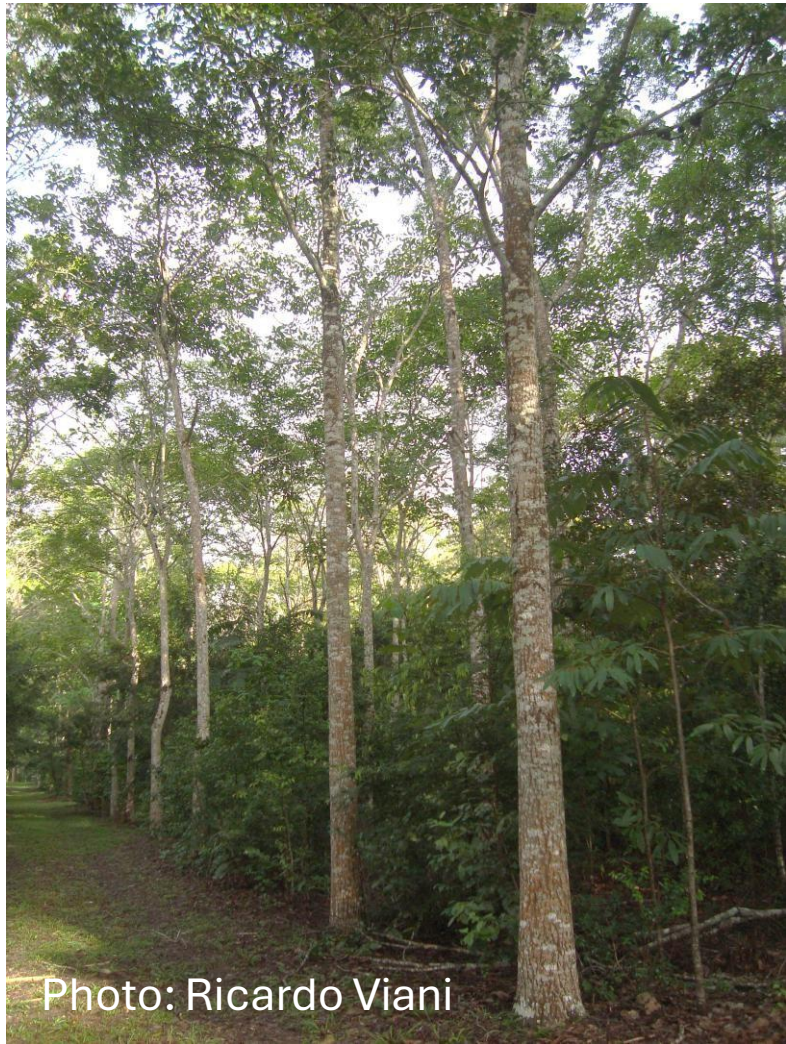


Photo: Ricardo Viani

BNDES

BEZOS EARTH FUND

https://coalizaobr.com.br/en/nativespecies/

Opportunities for collaboration

- ✓ Species selection and forest restoration strategies
- ✓ Carbon accounting and biodiversity monitoring in restoration projects
- ✓ Productive restoration and silviculture of native trees

Thank you!

viani@ufscar.br
www.laspef.com.br

Laspef UFSCar