

Tree diversity increases litter decomposition by increasing litterfall and microbial processes

Rémy Beugnon – Young Soil Researchers Forum



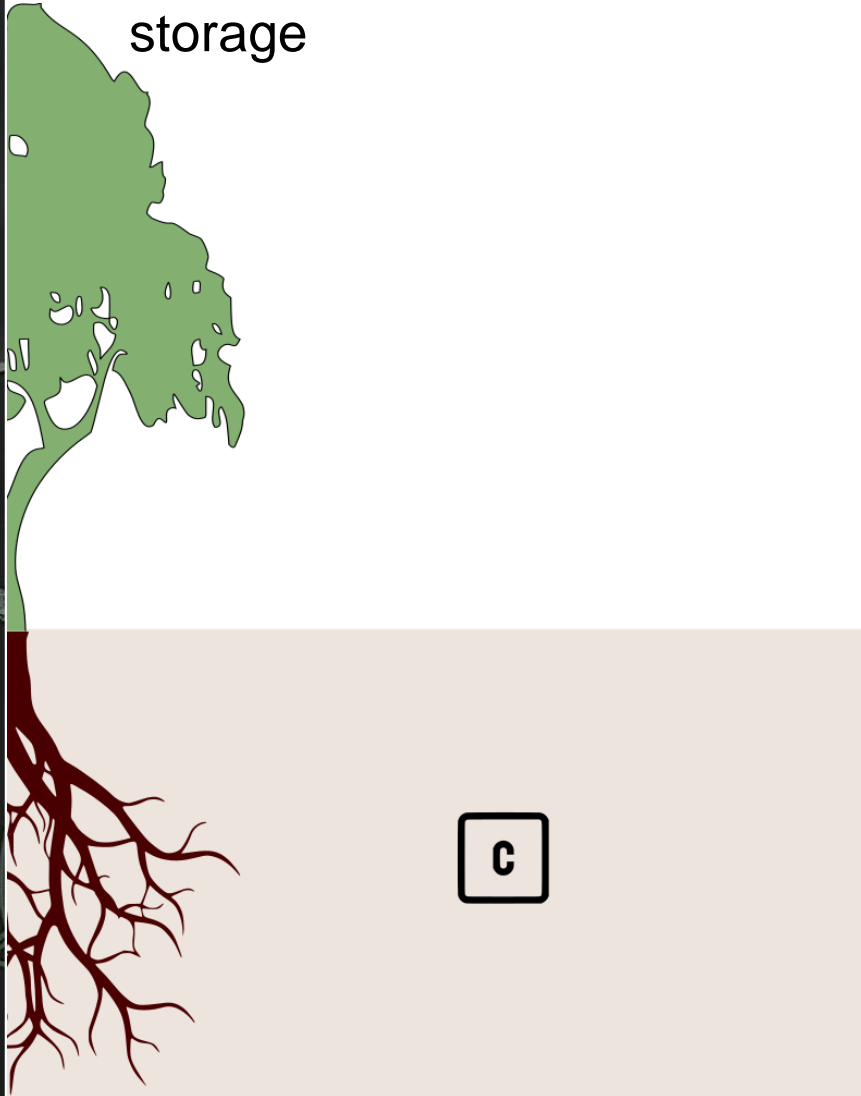
@BeugnonRemy

experimental
interaction
ecology



Introduction

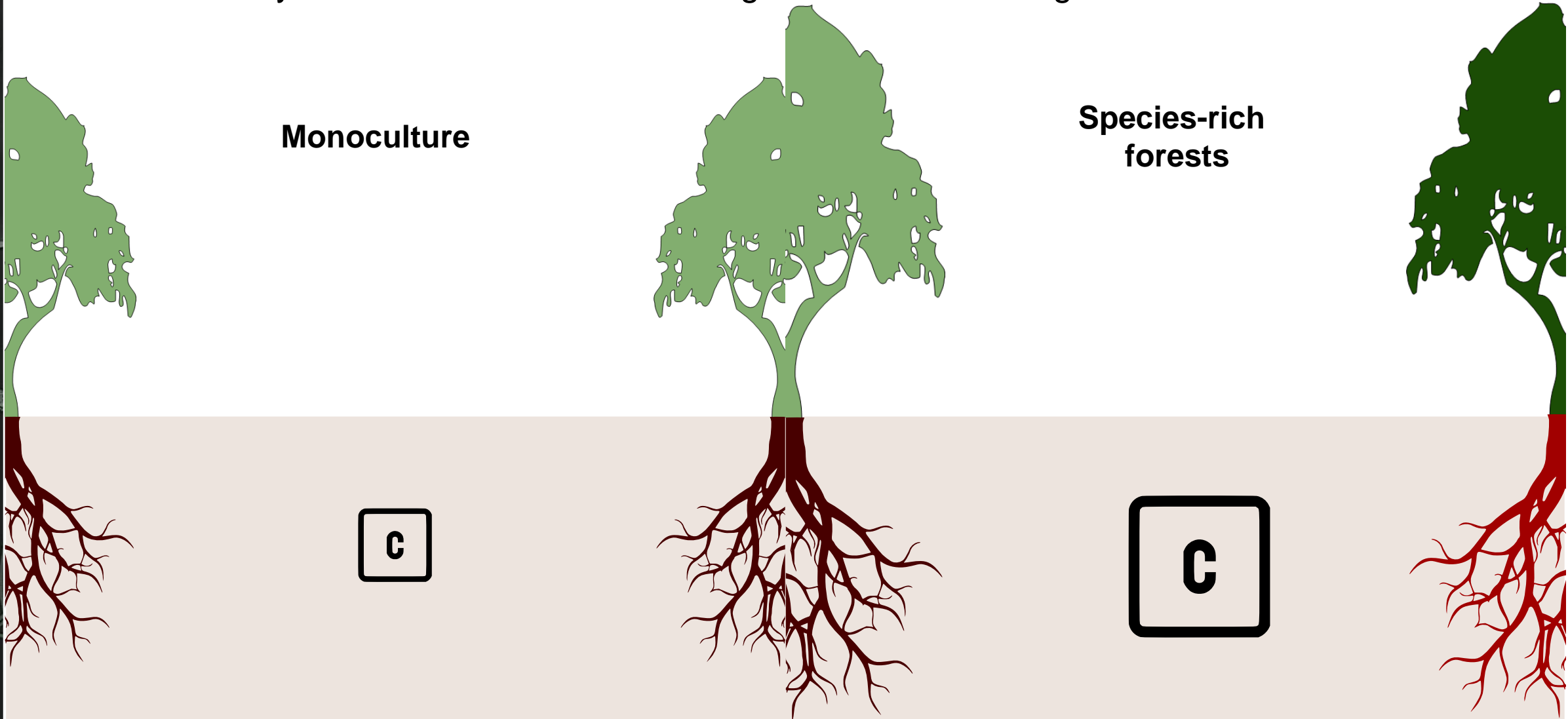
- Using forests to mitigate increasing atmospheric carbon by above- and belowground carbon storage



Introduction

Liang *et al.* 2016; Liu *et al.* 2018; Xu *et al.* 2020

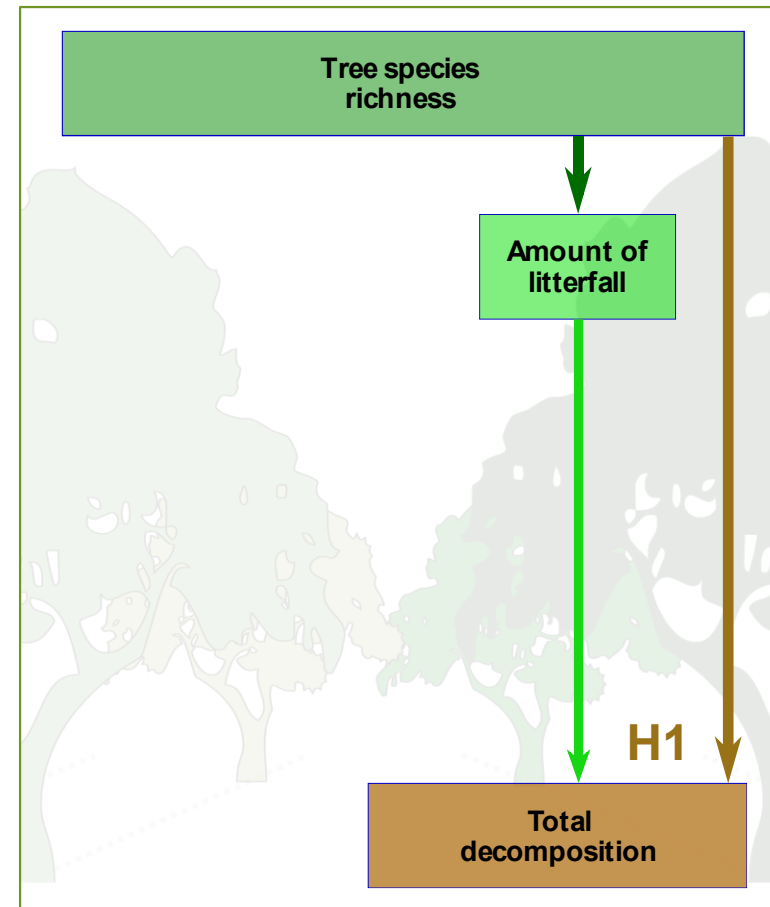
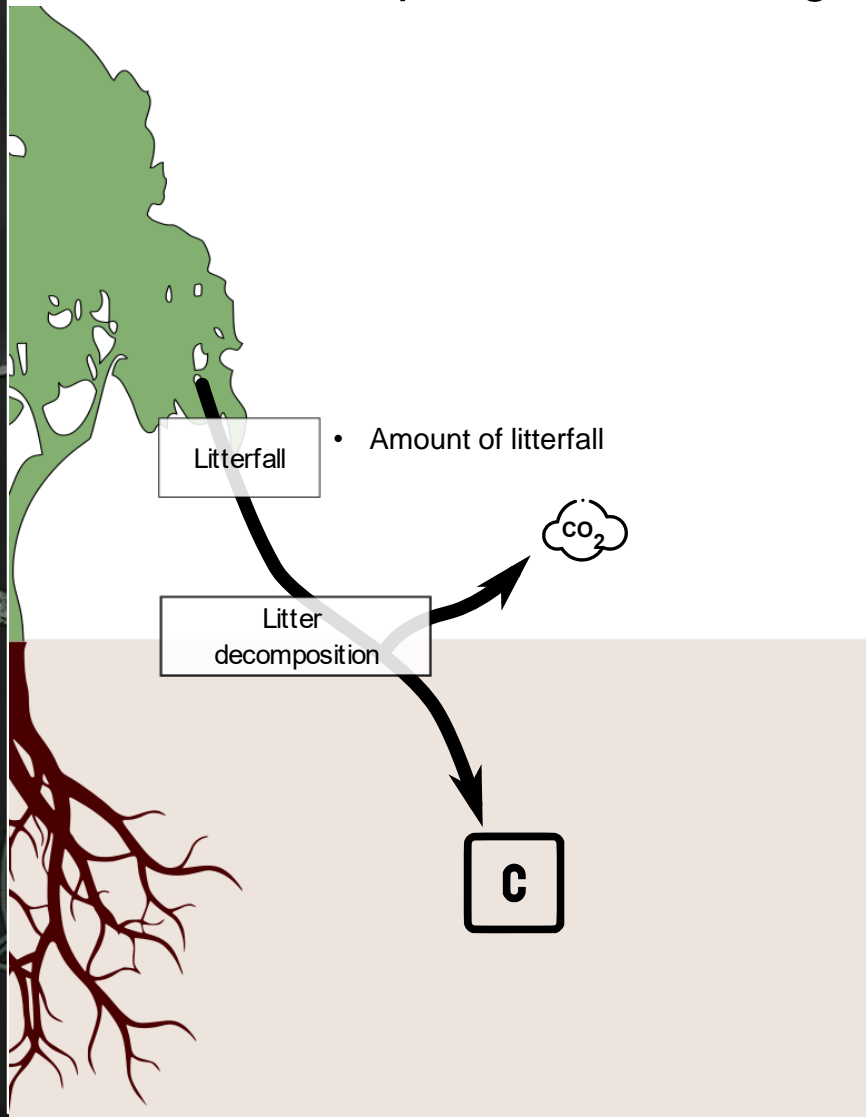
- Tree diversity enhances above- and belowground carbon storage



Introduction

Wardle *et al.* 2004

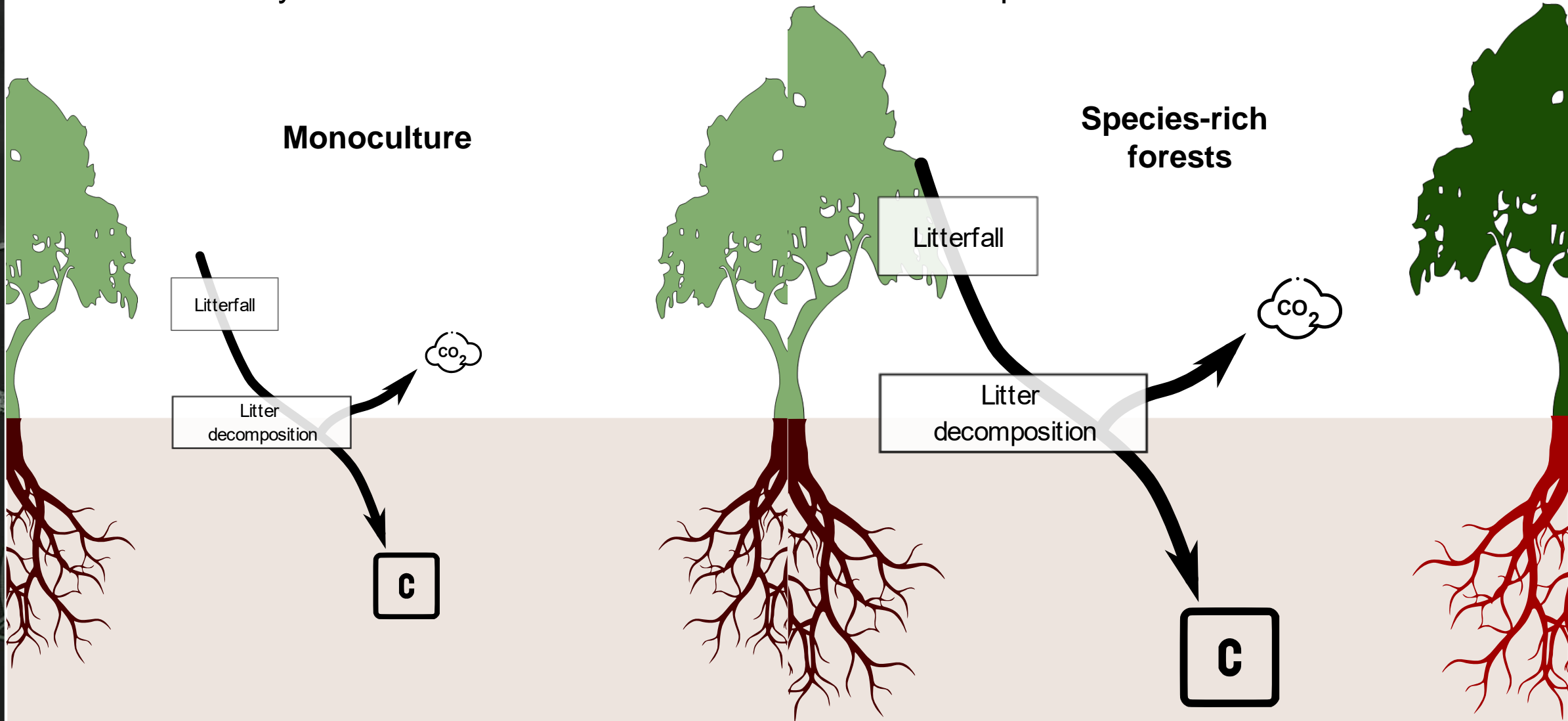
- Forest leaf production is integrated into soil by litter decomposition



Introduction

Huang *et al.* 2017, Gessner *et al.* 2010, Joly *et al.* 2017

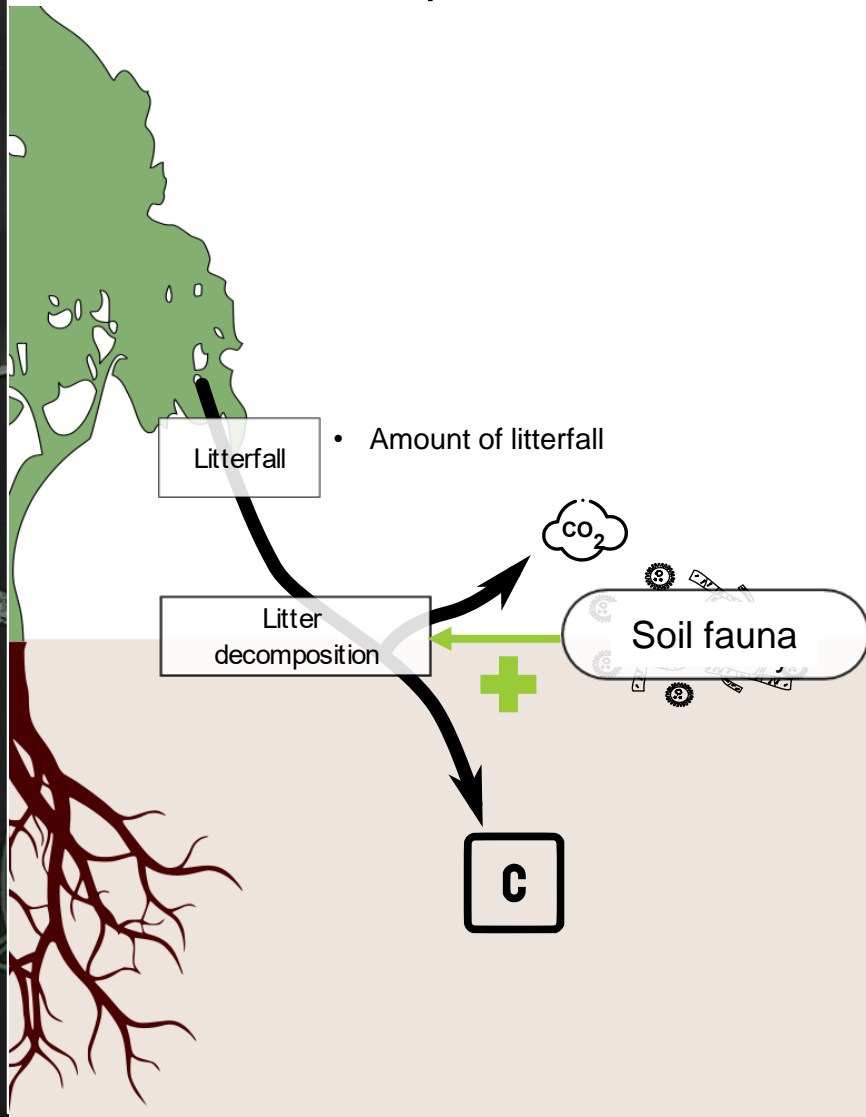
- Tree diversity enhances amount of litterfall and litter decomposition



Introduction

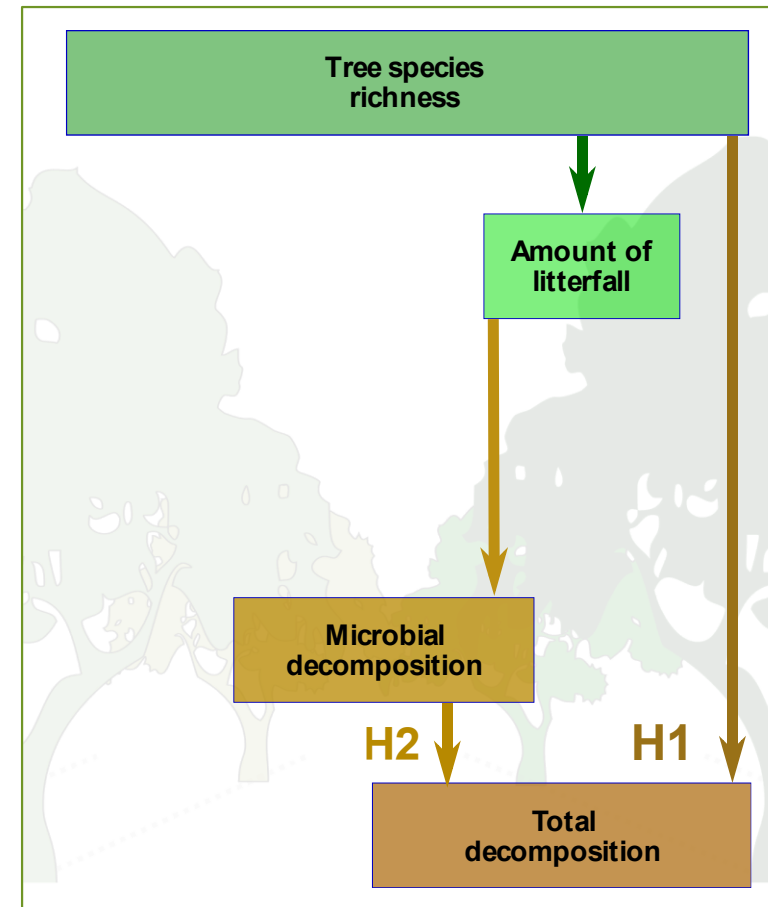
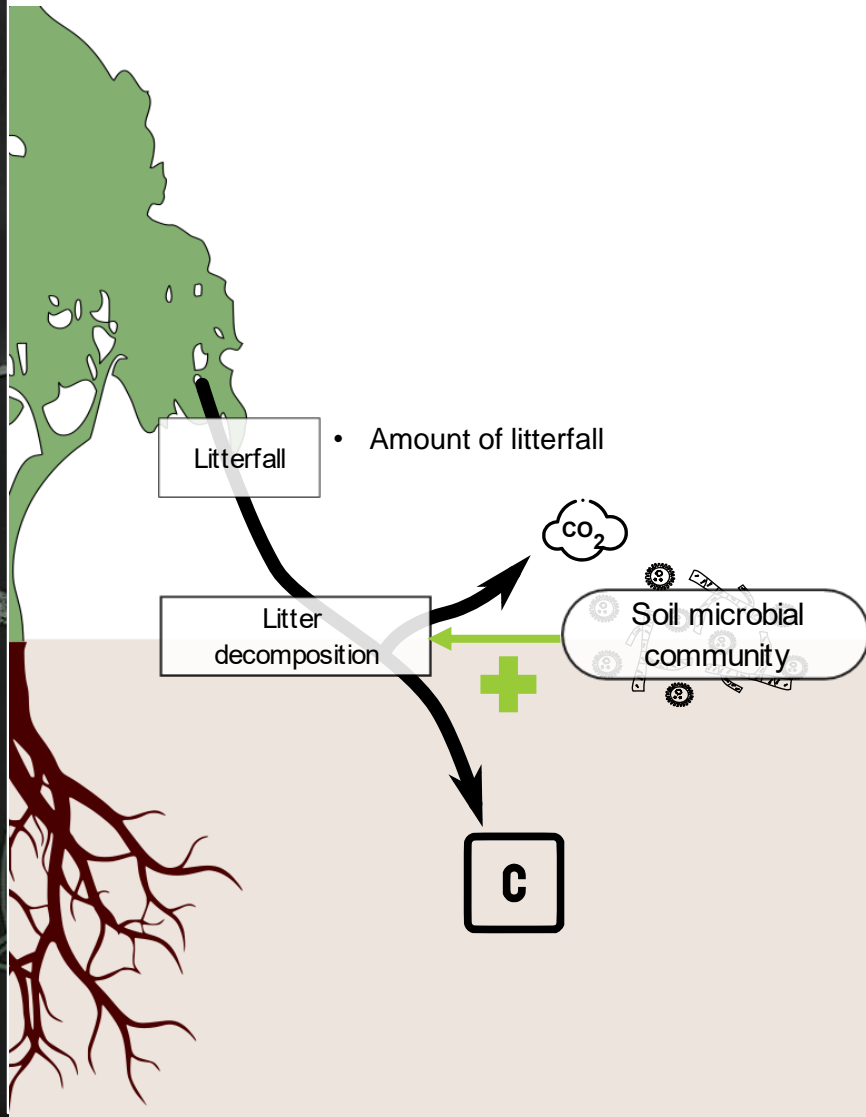
García-Palacios *et al.* 2013

- Litter decomposition is carried out by soil fauna



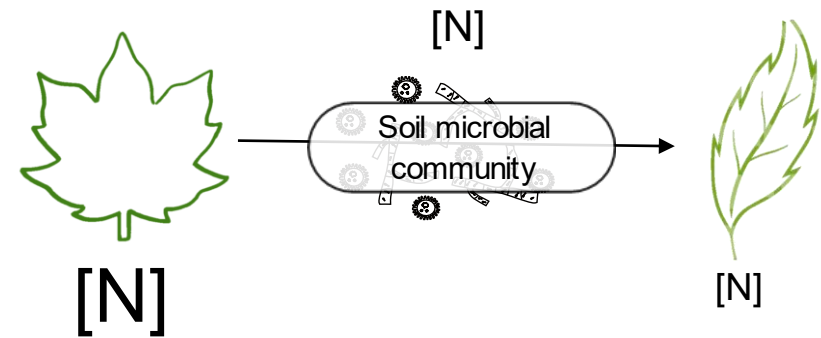
Introduction

- Litter decomposition is carried out by soil microbial community when soil meso- macrofauna are limited

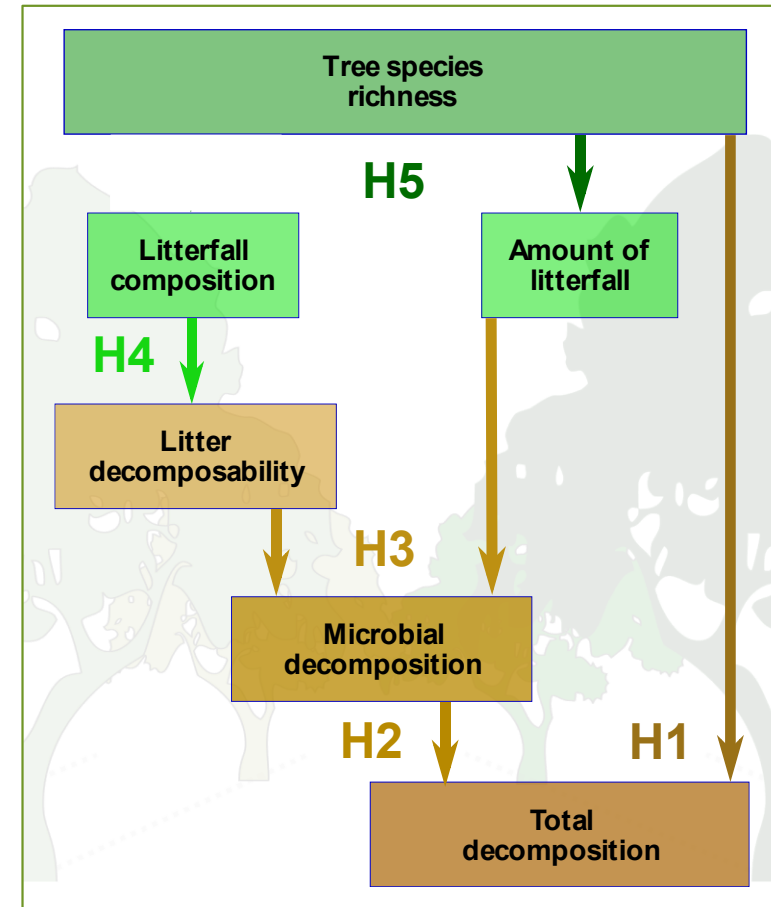
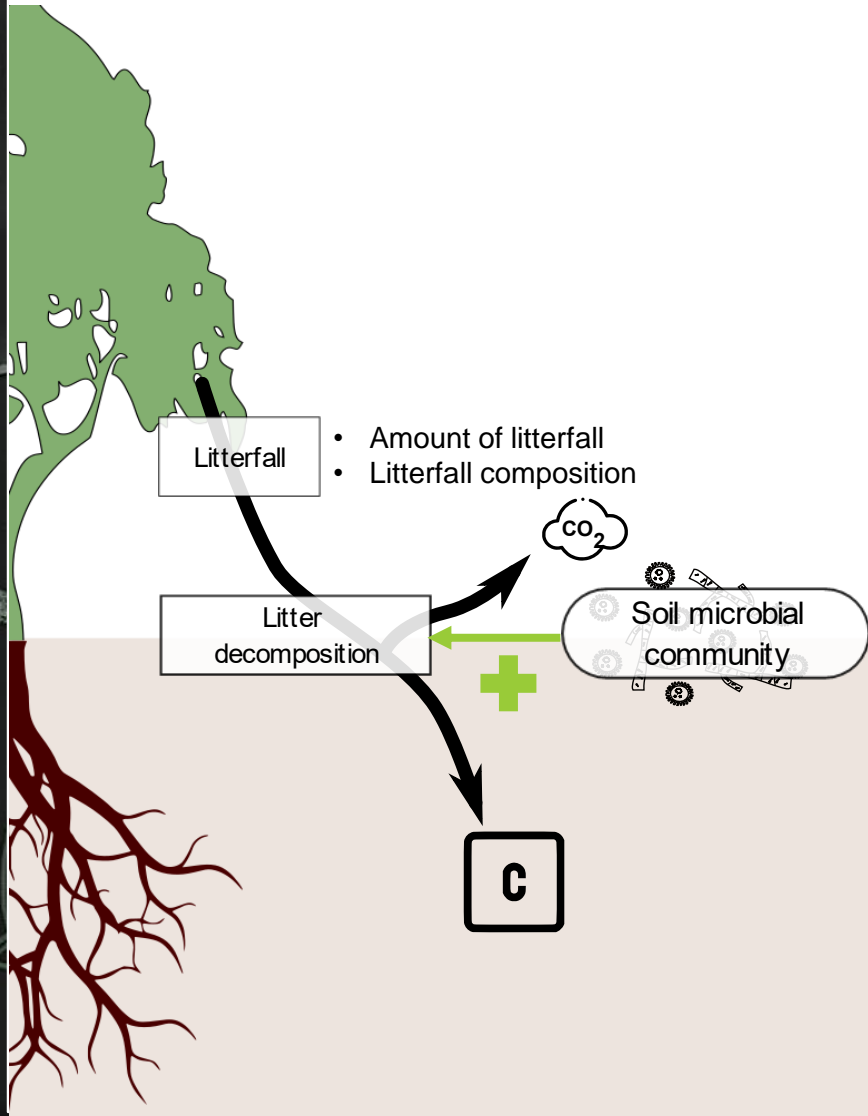


Introduction

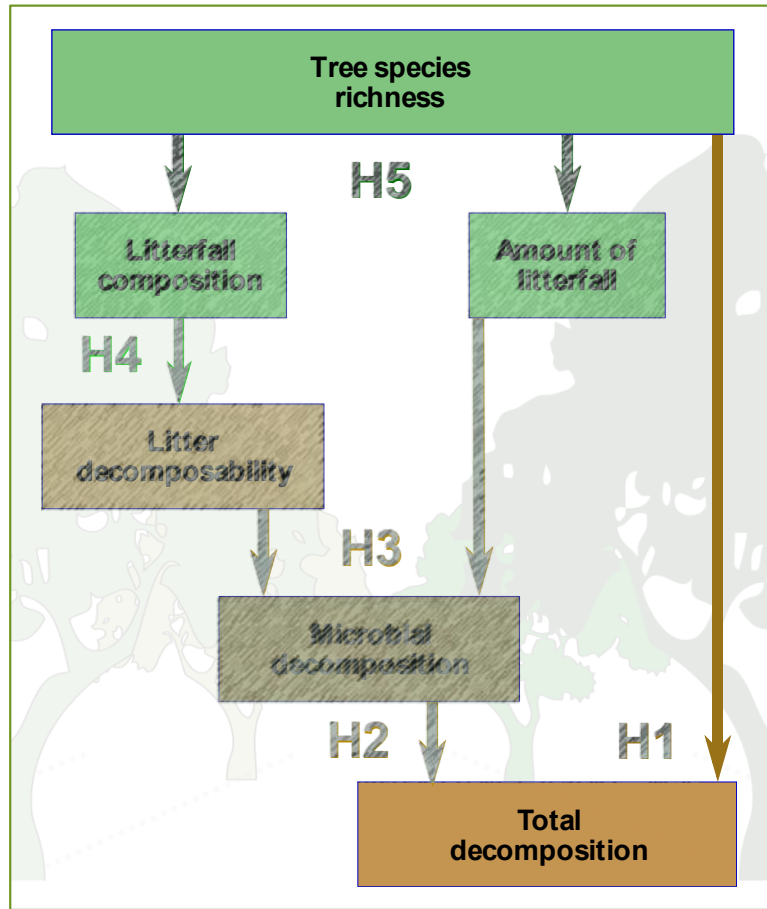
- Litter decomposability (susceptibility of litter to decomposition) increases with litter species richness



Introduction

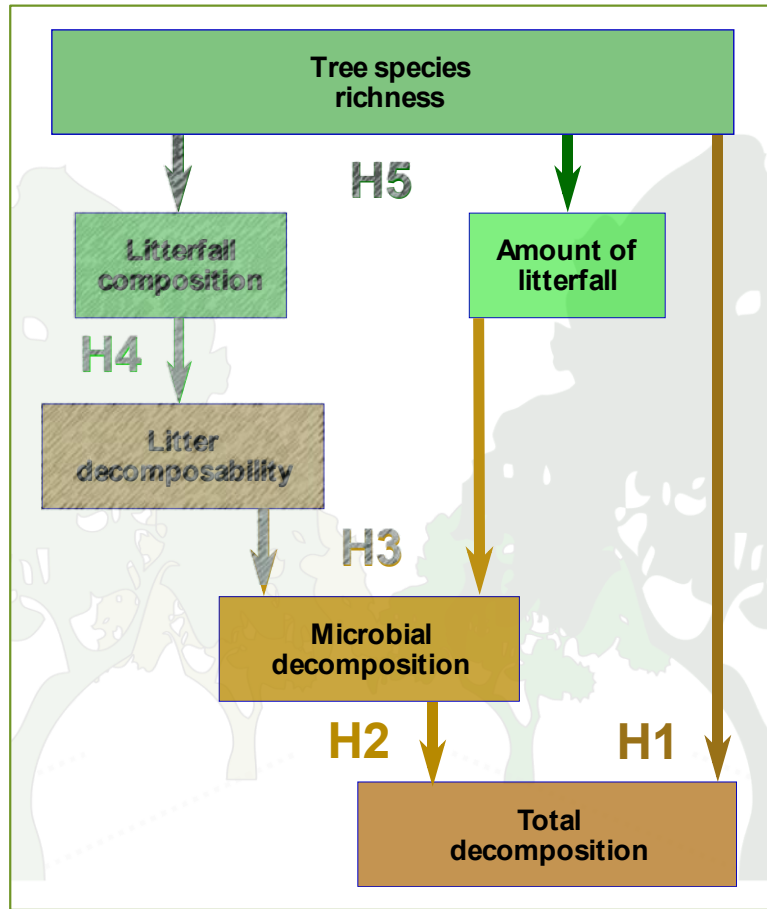


Introduction



H1 - tree species richness increases litter decomposition

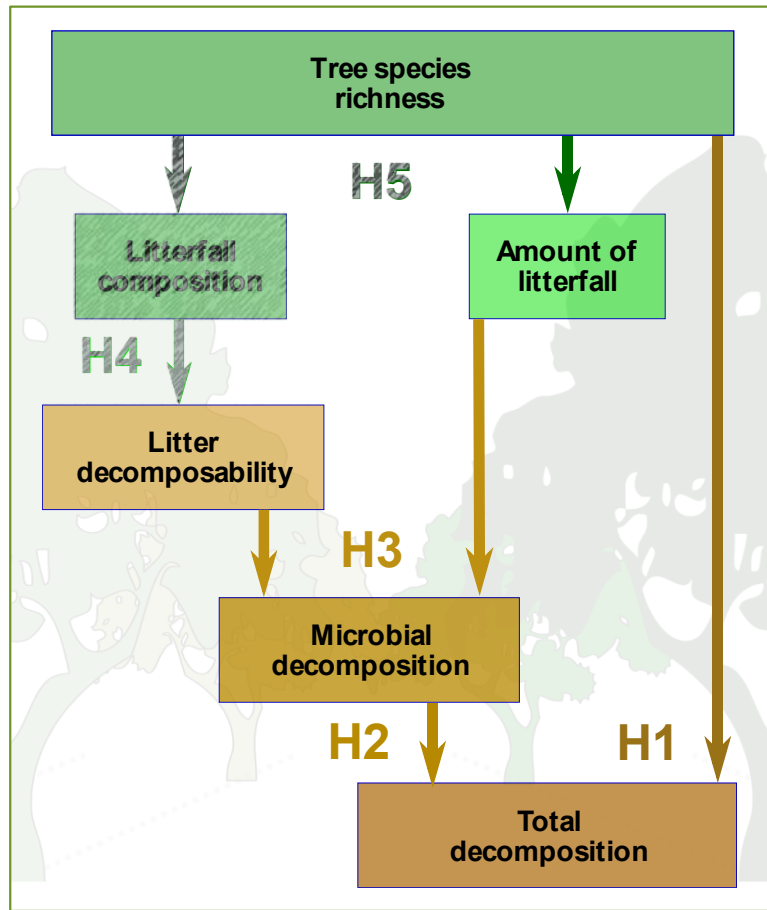
Introduction



H1 - tree species richness increases litter decomposition

H2 - litter decomposition is mostly carried out by the soil microbial community

Introduction

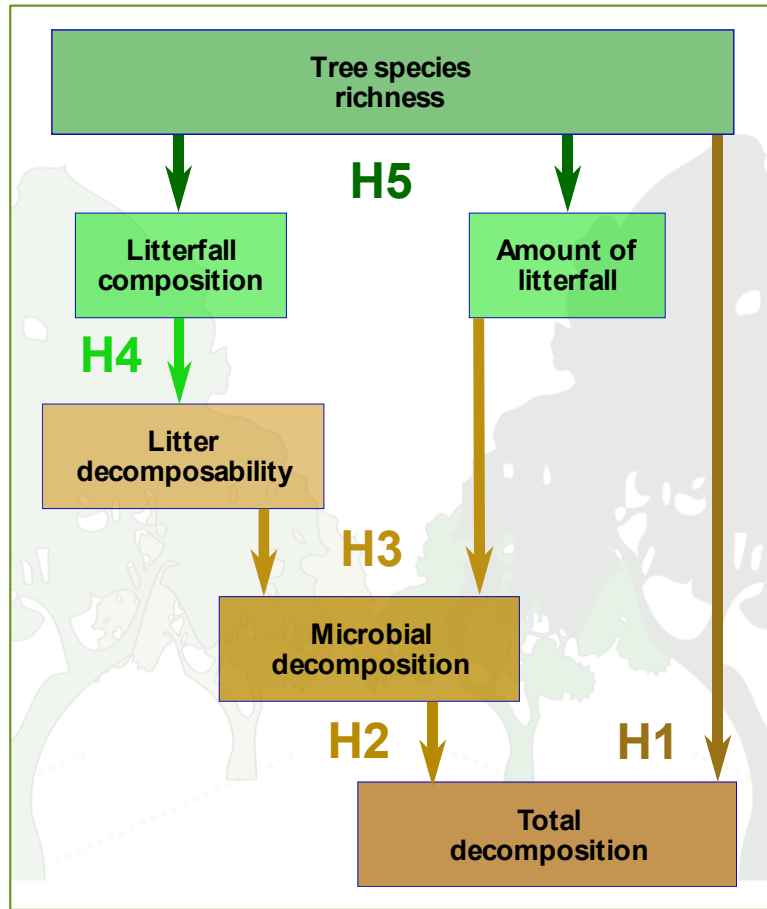


H1 - tree species richness increases litter decomposition

H2 - litter decomposition is mostly carried out by the soil microbial community

H3 - microbial decomposition increases with litter decomposability (i.e., litter decomposition measured in a controlled environment)

Introduction



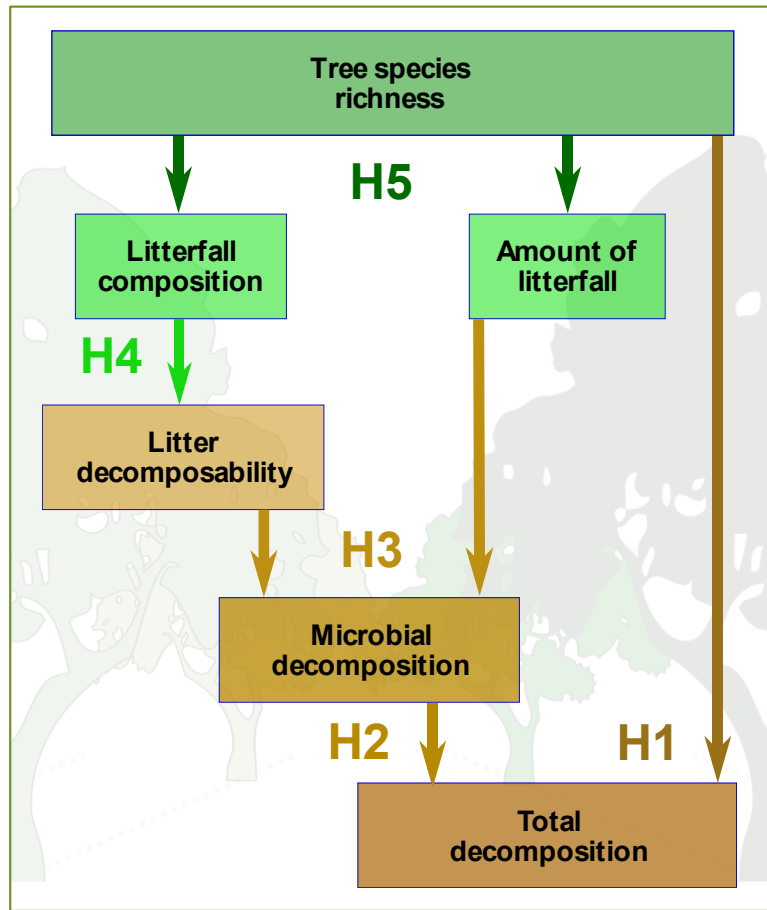
H1 - tree species richness increases litter decomposition

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H4 - litter species richness and functional traits increase litter decomposability

Introduction



H1 - tree species richness increases litter decomposition

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H3 - microbial decomposition increases with litter decomposability (i.e., litter decomposition measured in a controlled environment)

H4 - litter species richness and functional traits increase litter decomposability

H5 – amount and composition of litterfall is driven by tree species richness

Methods

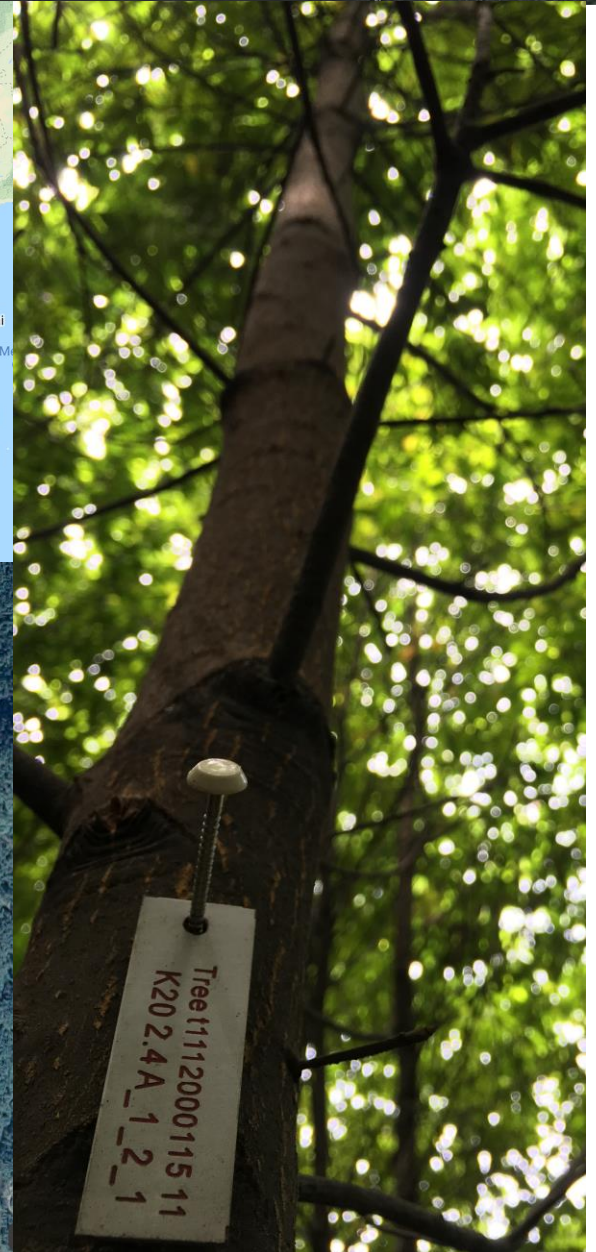
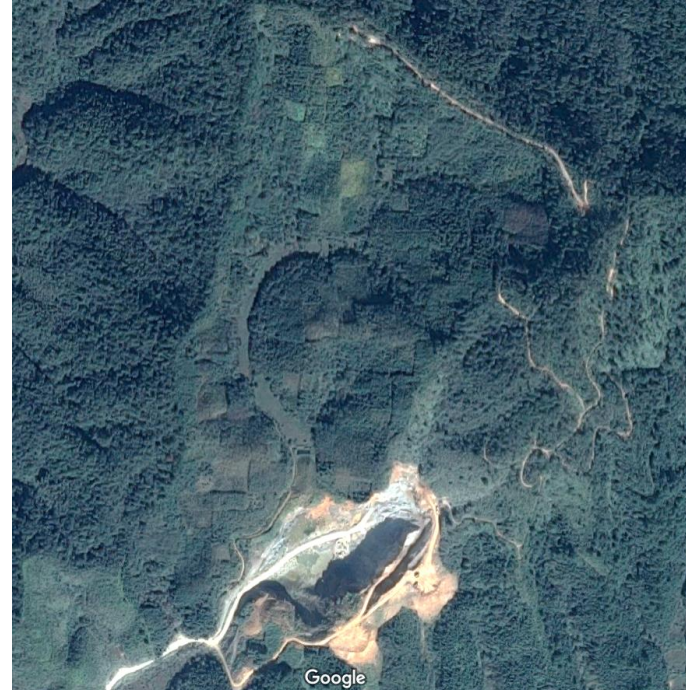
South-East China

Subtropical climate: warm, rainy summers
& cool, dry winters

BEF China platform:

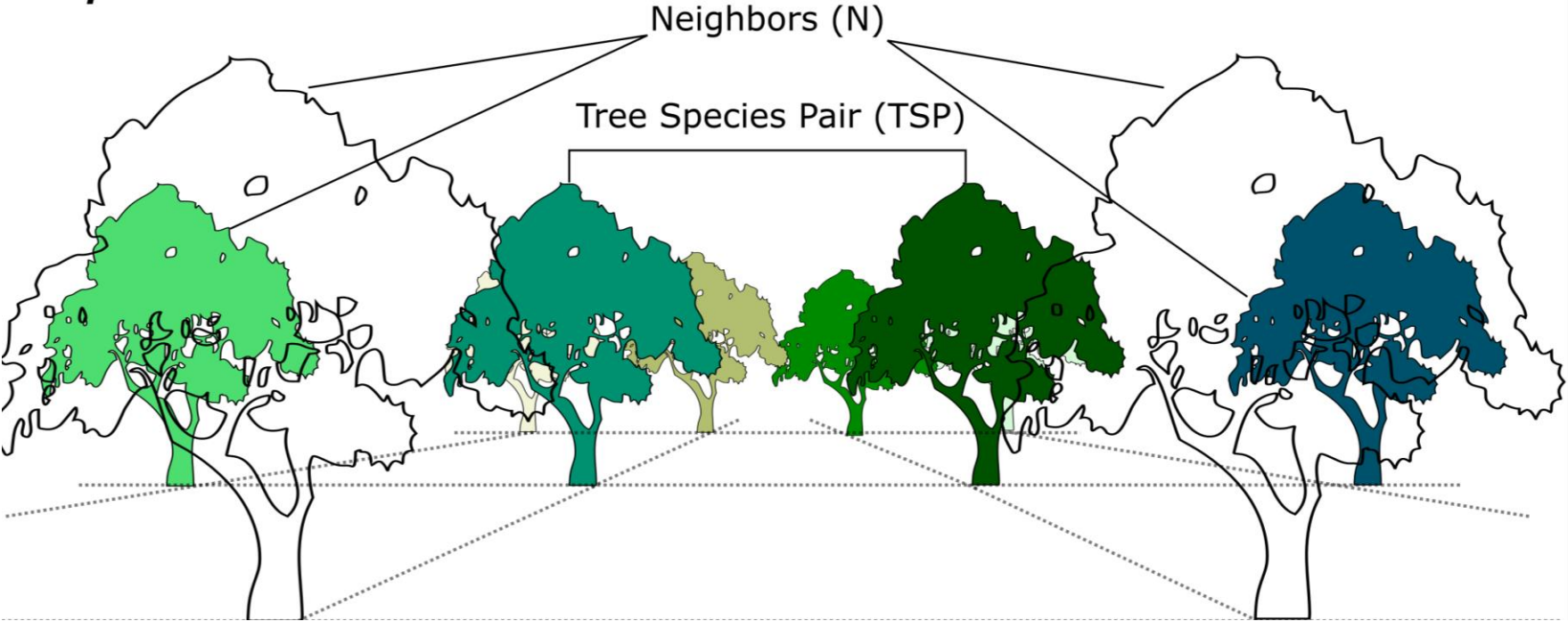
Tree diversity experiment (since 2009)

Species richness manipulated from 1 to 16,
planted in a random scenario



Experimental design

Perspective view



Sampling & measurements

Tree species pairs (TSP)

TSP → Sept. 2018 → Leaf functional traits (SLA, LDMC, C, N ...)

Litterfall's amount and species composition

Sept. - Dec. 2018

Litterbags filling & fauna exclusion treatment

■ x4 ■ x2

TSP decomposition experiment

Dec. 2018

Common garden decomposition experiment

Sept. 2019

Decomposition measurements:
(C and N loss)

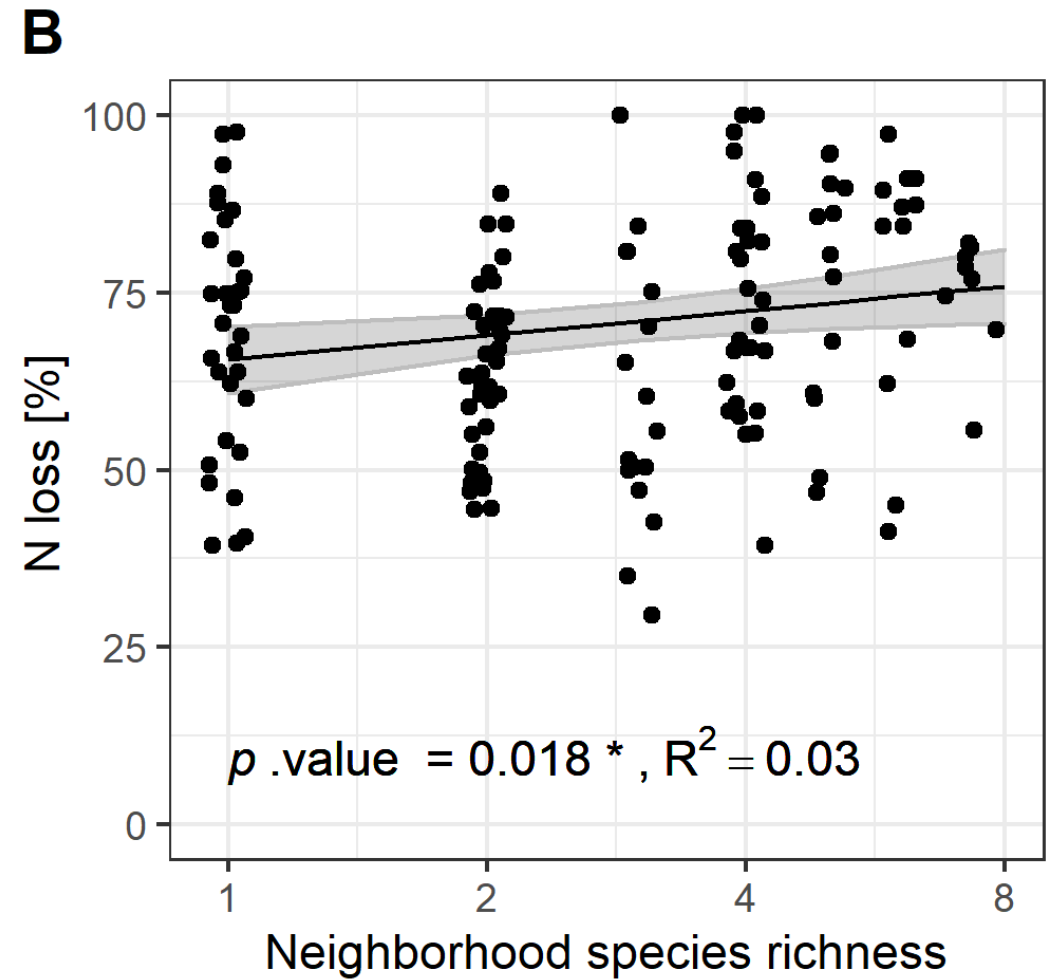
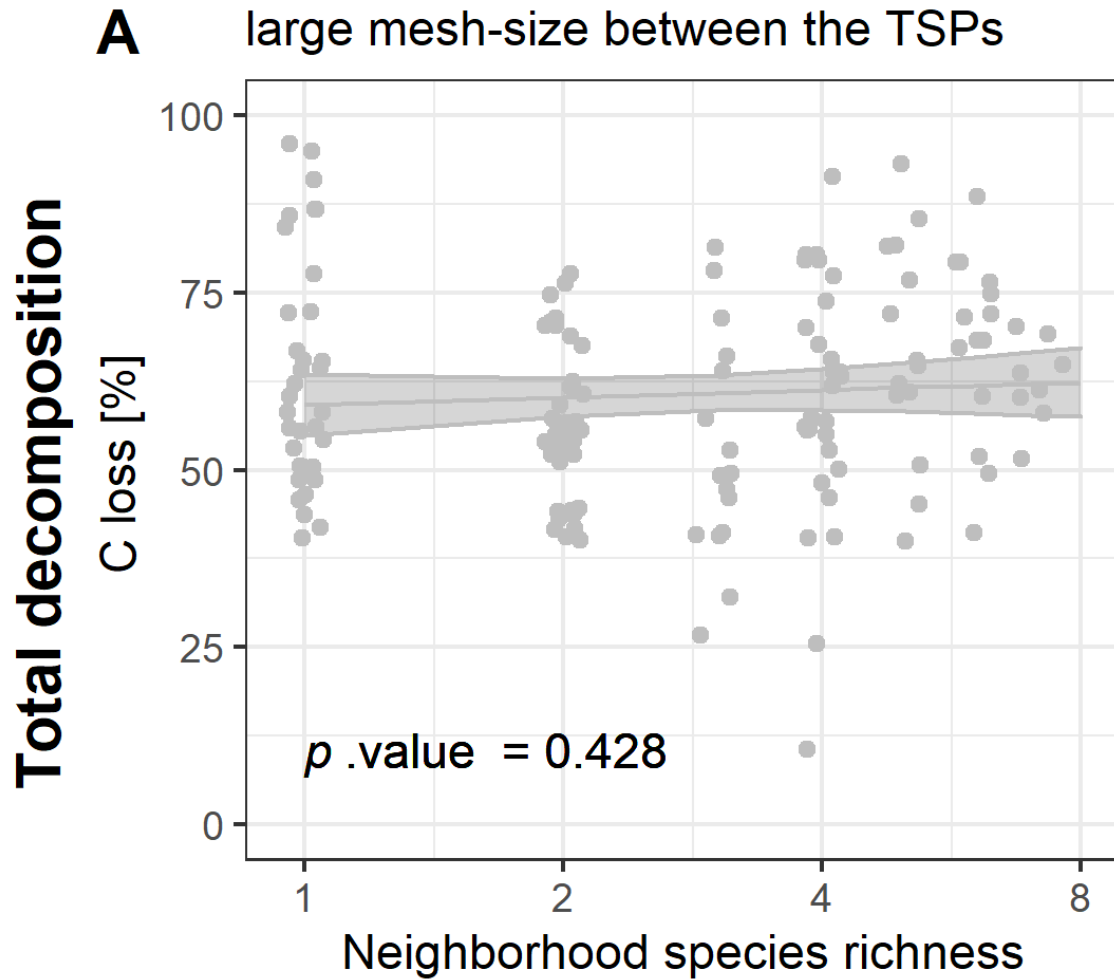
Total decomposition: 5 mm-mesh between the TSPs

Microbial decomposition: 0.054 mm-mesh between the TSPs

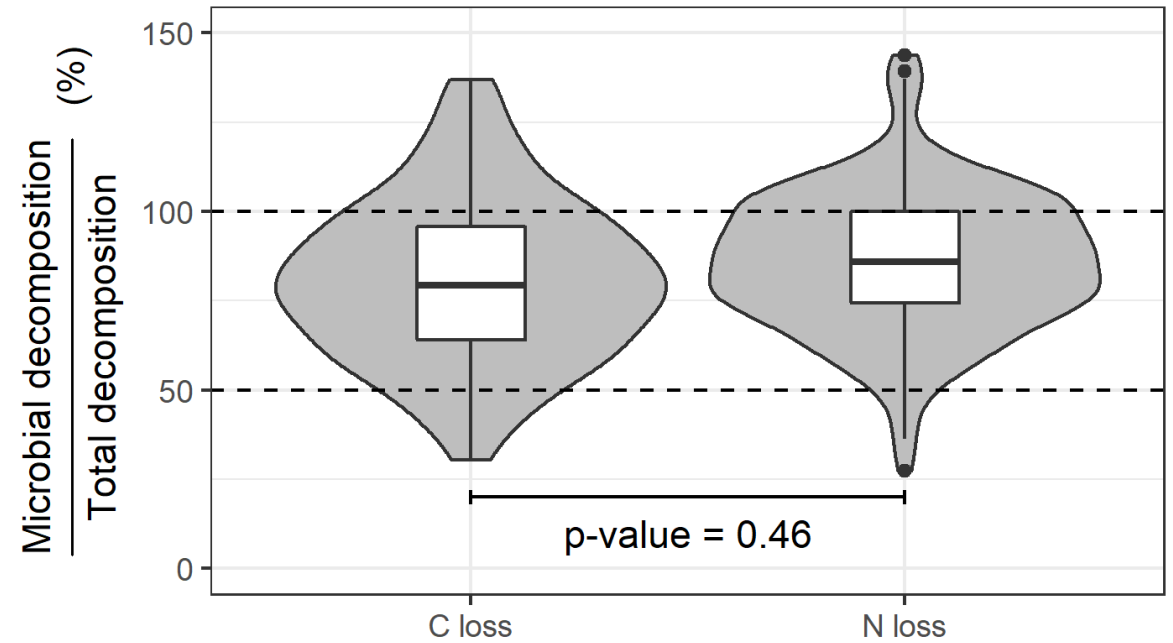
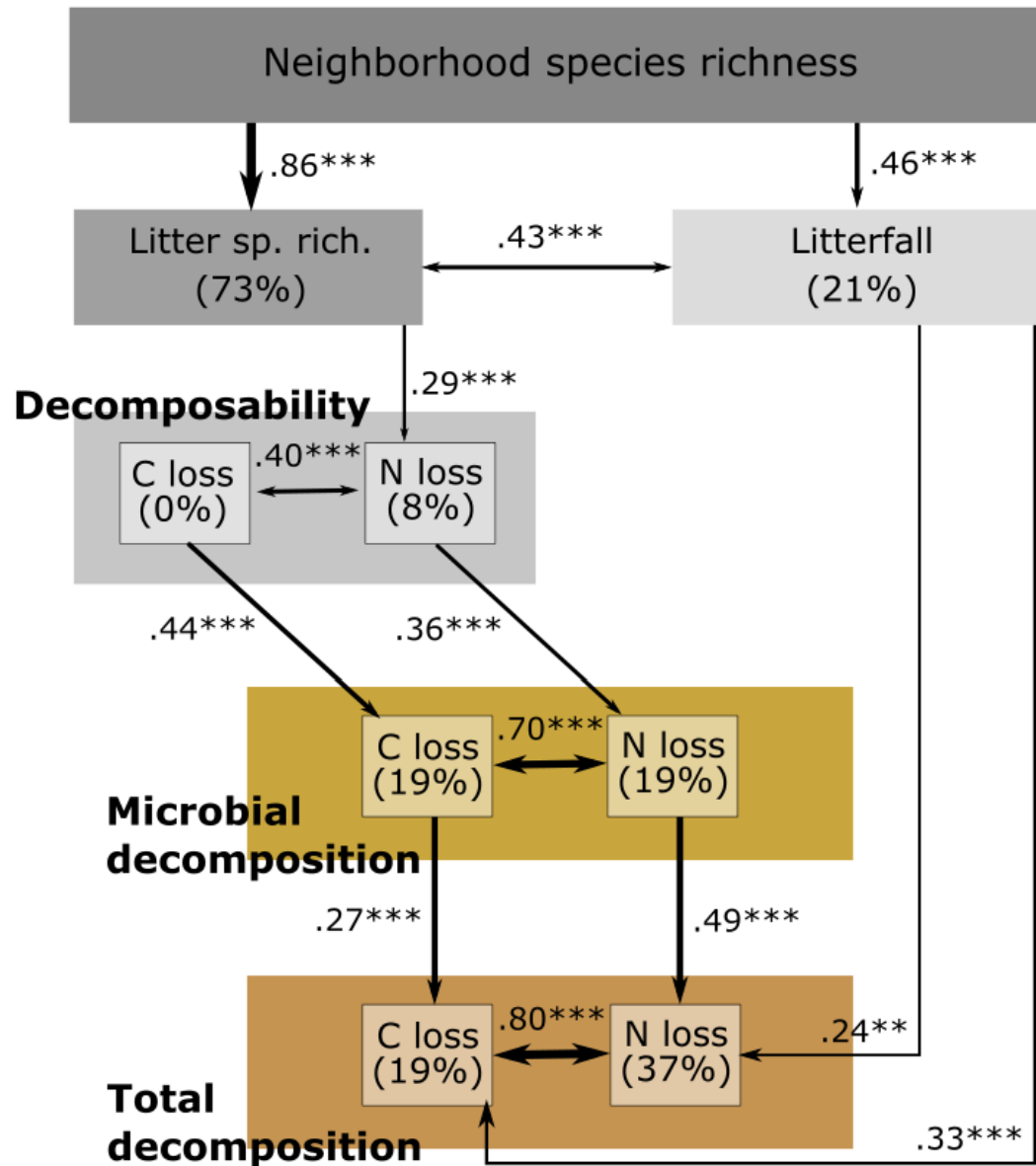
Litter decomposability: 0.054 mm-mesh in the Common Garden experiment (monoculture of *Shima Superba*)

Results: tree species richness increased decomposition

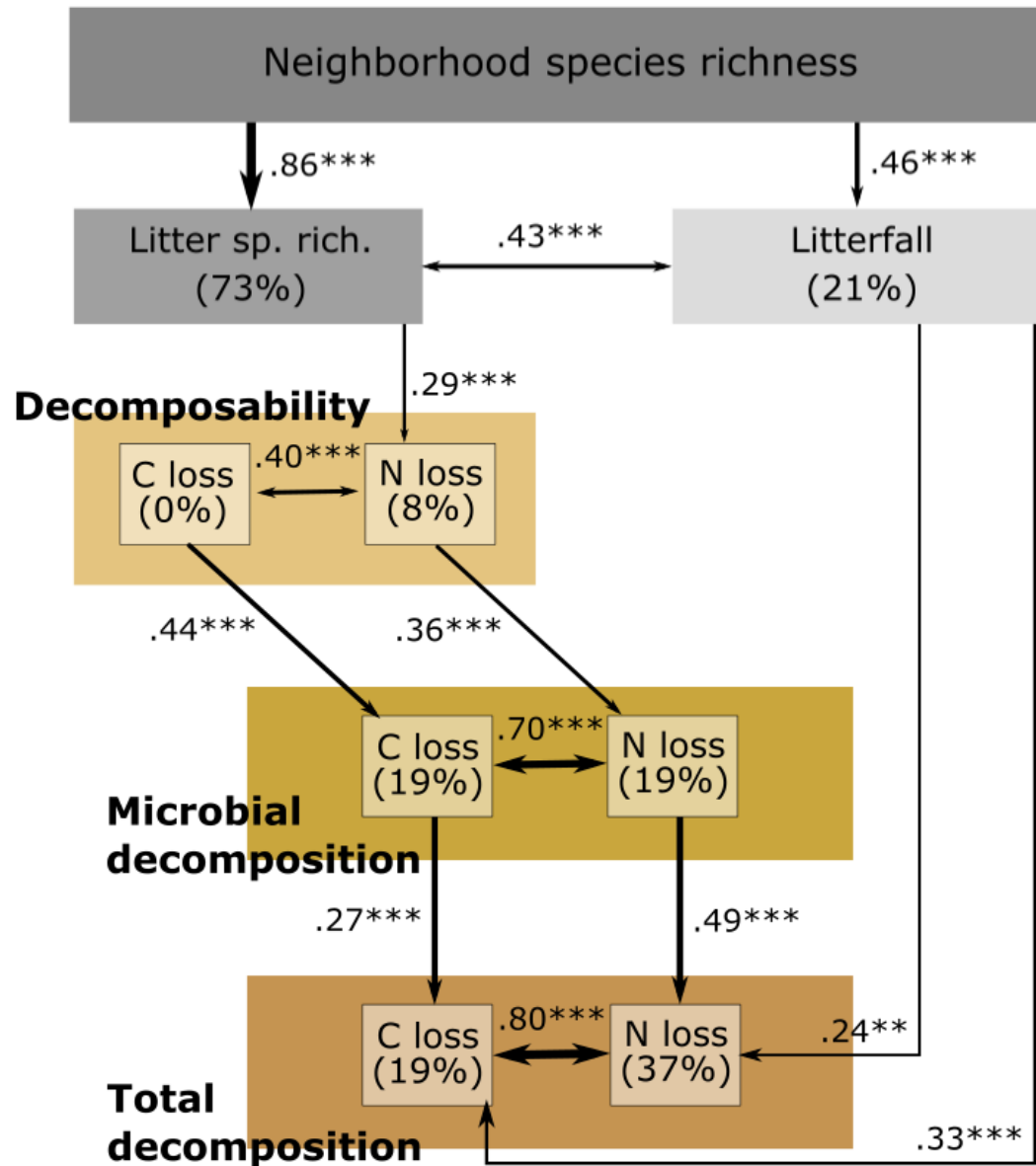
TSP decomposition experiment



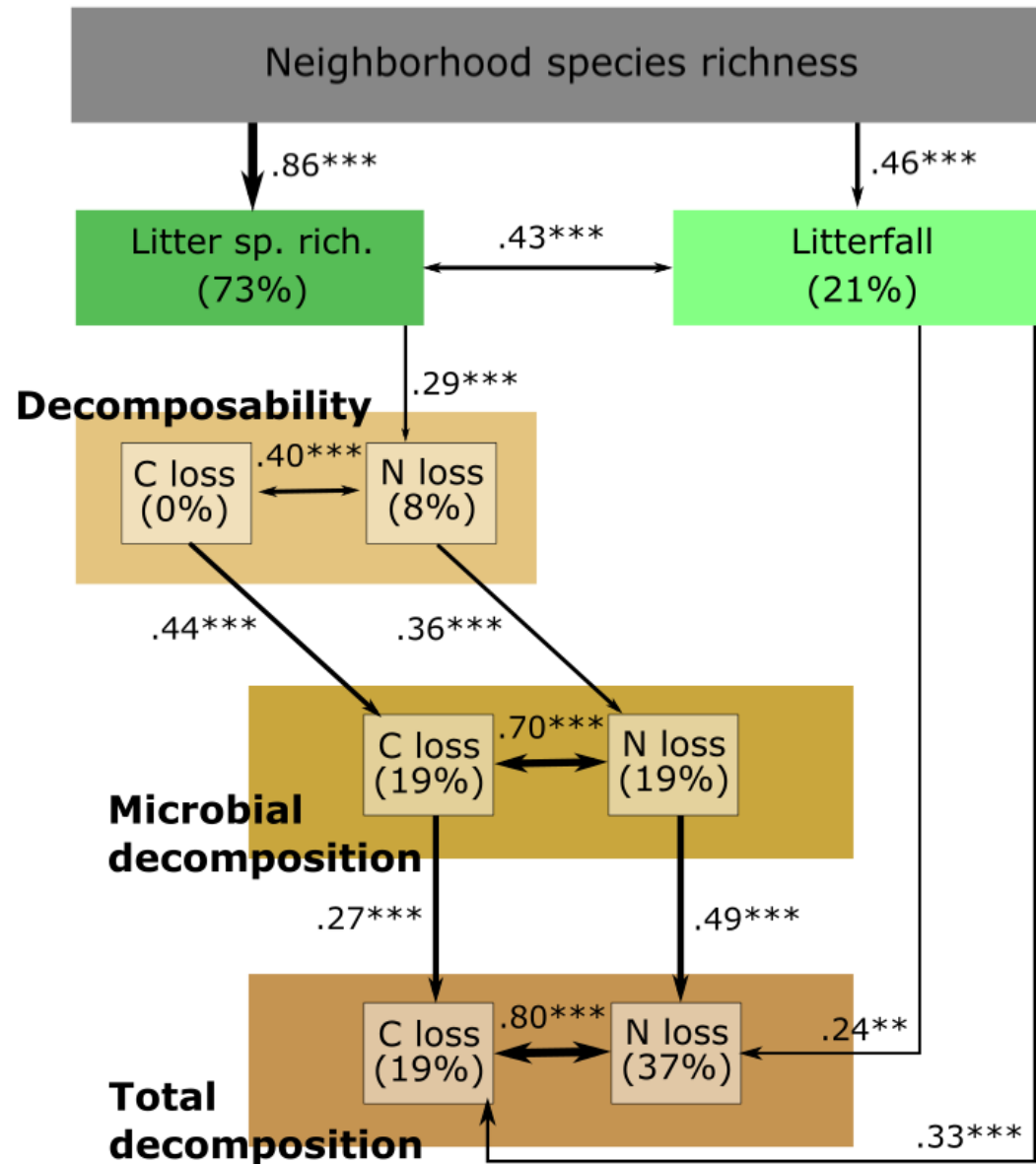
Results: litter decomposition was mostly carried by the microbial community



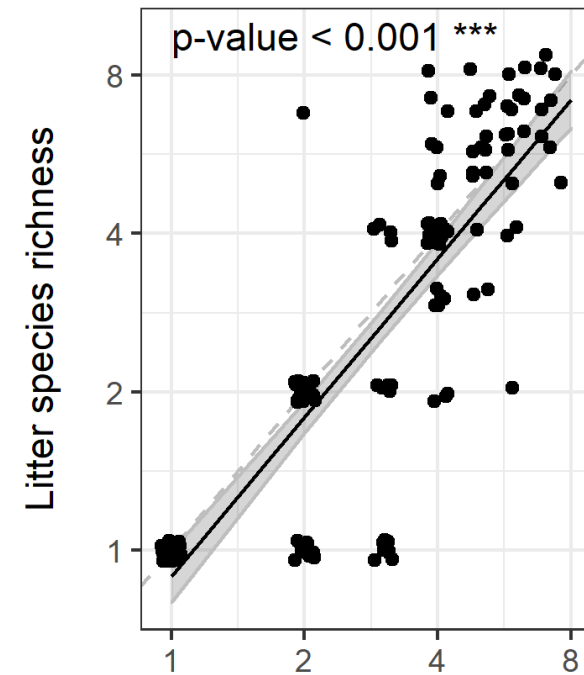
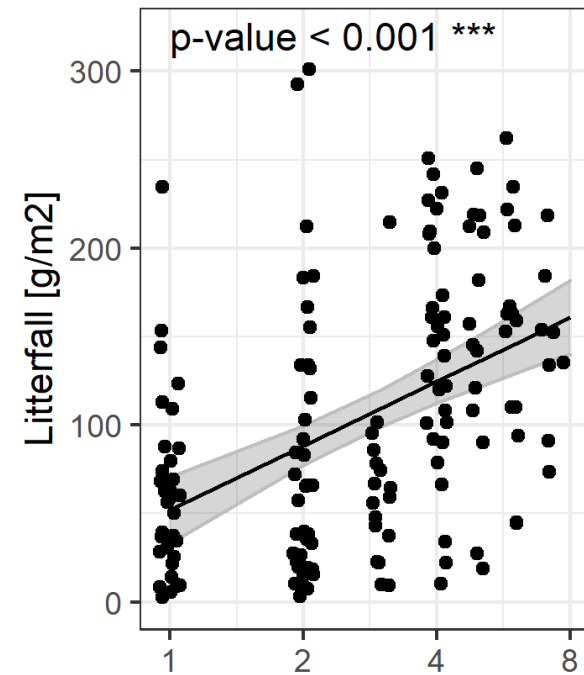
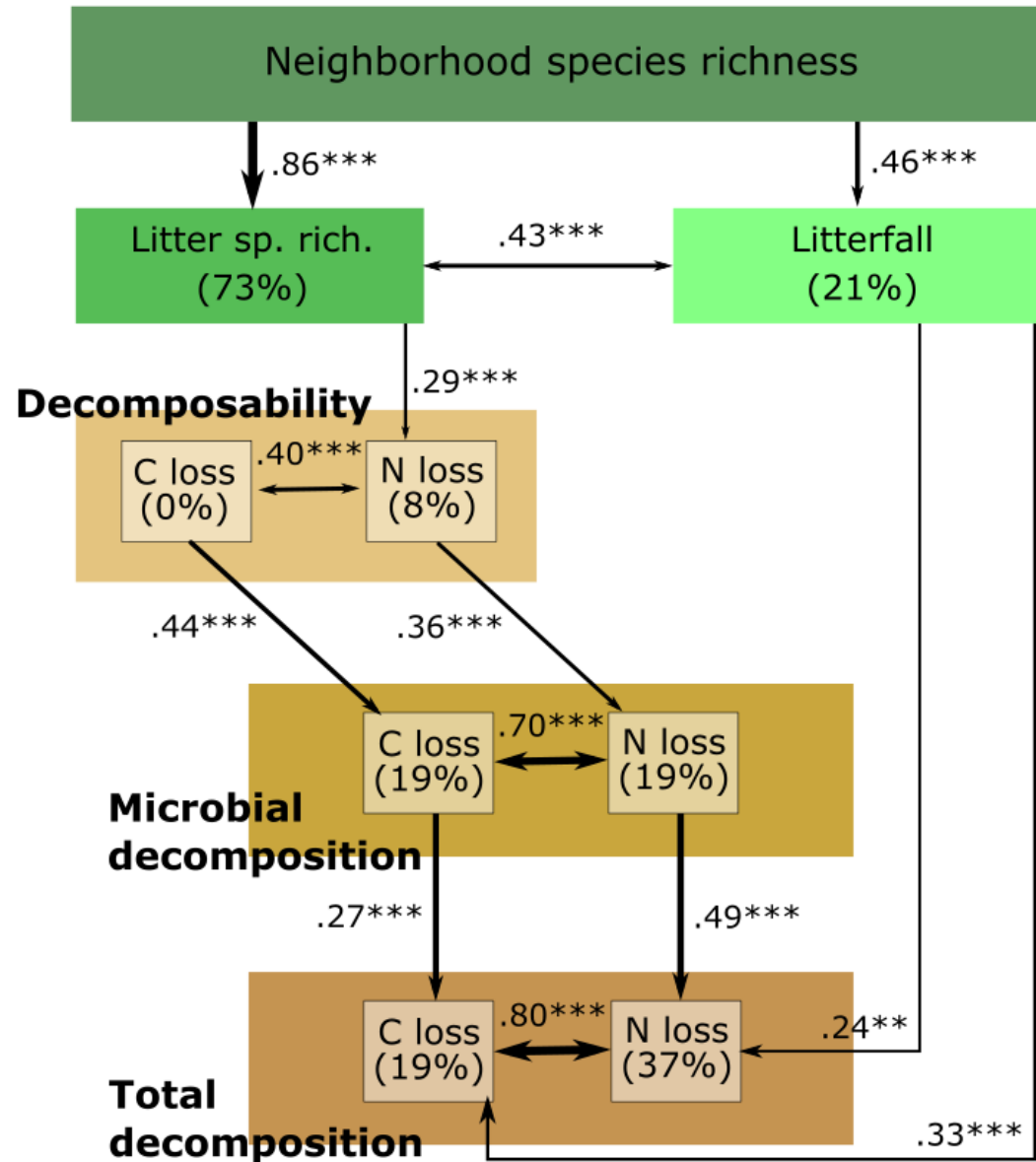
Results: litter decomposition increased with litter decomposability



Results: amount and species richness of the litterfall enhanced decomposition



Results: tree species richness increased both amount and diversity of litterfall

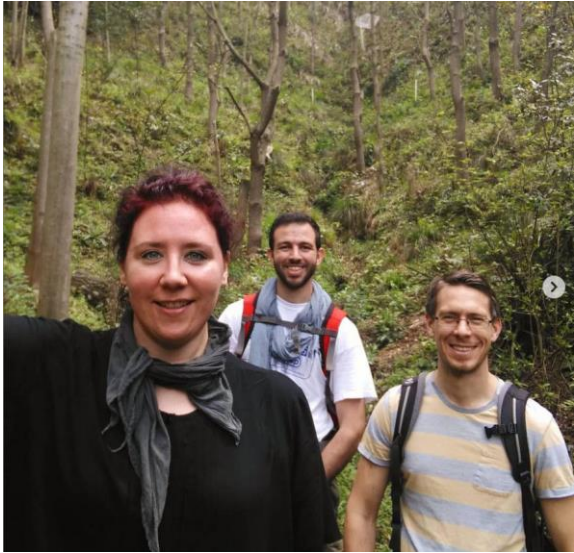


Neighborhood species richness

Tree diversity enhances litter decomposition

- By increasing the amount and diversity of litterfall
- By increasing microbial processes
- By increasing litter decomposability

Planting diverse forest will increase forest carbon cycling by increasing litter production and decomposition



Simone Cesarz & Nico Eisenhauer

Field and lab helpers



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Bala Singavarapu, Marie Sünnemann,
Lise Thouvenot, Yanfen Wang,
Tesfaye Wubet, Kai Xue



TreeDi



experimental
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DFG Deutsche
Forschungsgemeinschaft

Thank you for your attention

