Tree diversity decomposition litterfall

Rémy Beugnon – GfÖ conference 2021

iDiv TreeDi @BeugnonRemy experimental interaction ecology

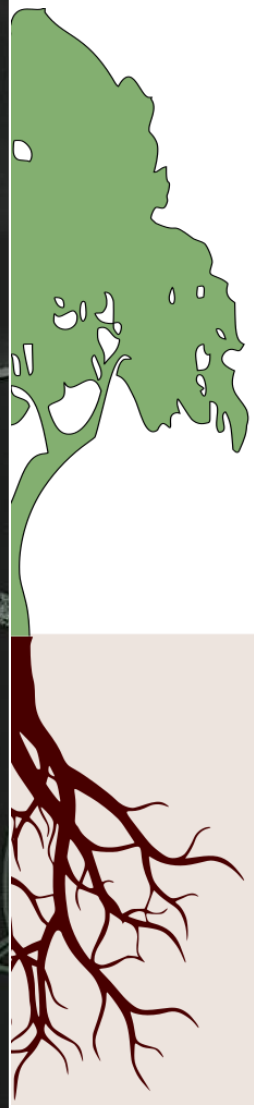
Introduction

- Using forests to mitigate increasing atmospheric carbon: aboveground

Bastin *et al.* 2019

Introduction

- Using forests to mitigate increasing atmospheric carbon: above- and belowground



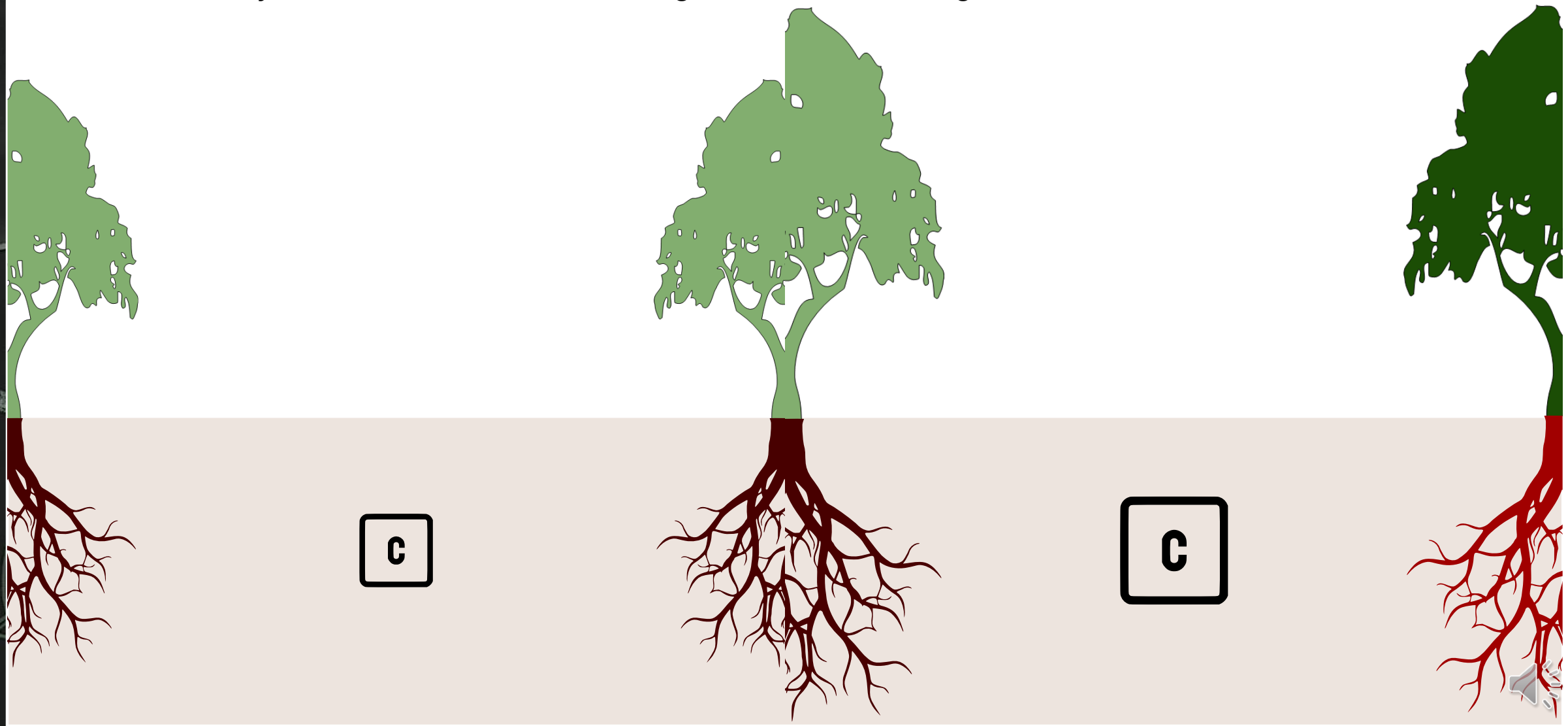
C

Bastin *et al.* 2019

Introduction

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

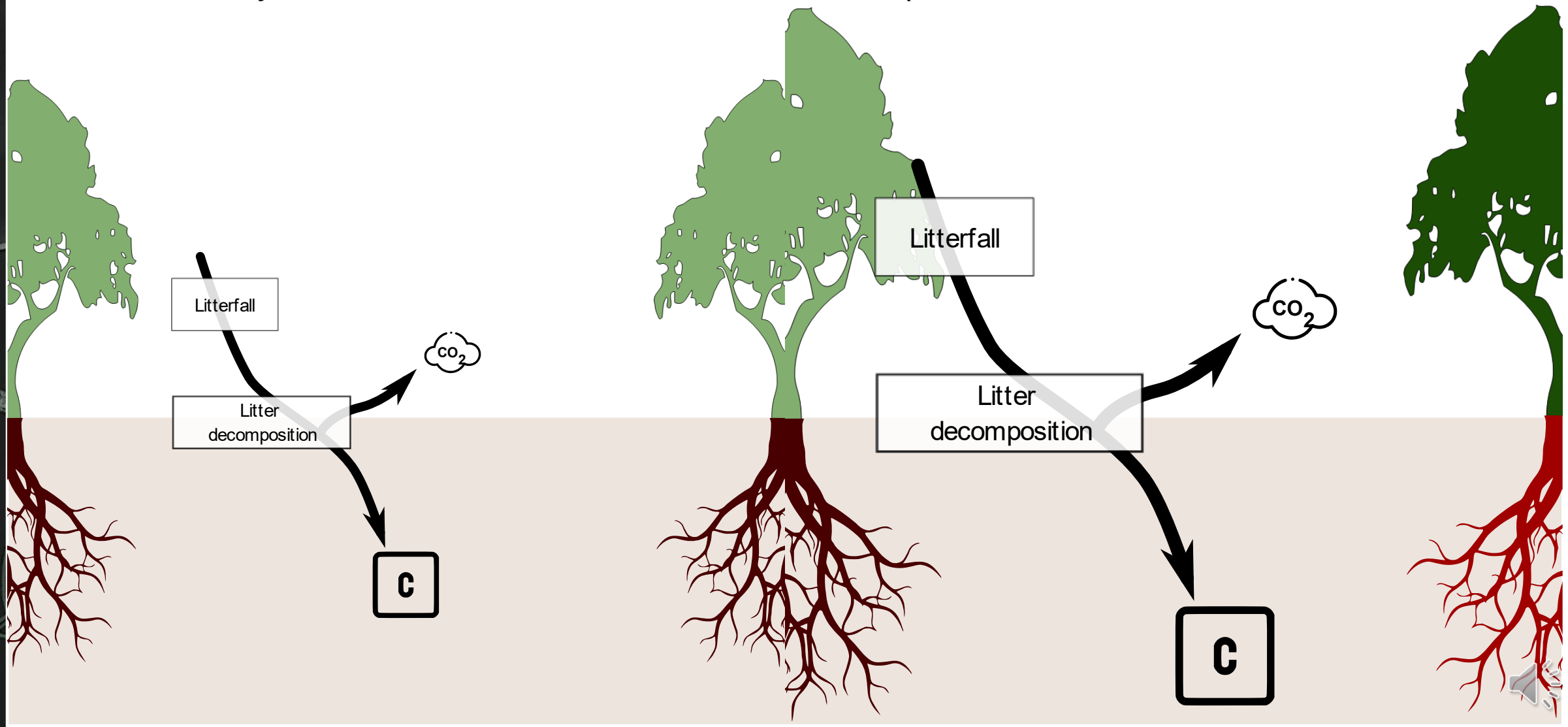
- Tree diversity enhances above- and belowground carbon storage



Introduction

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

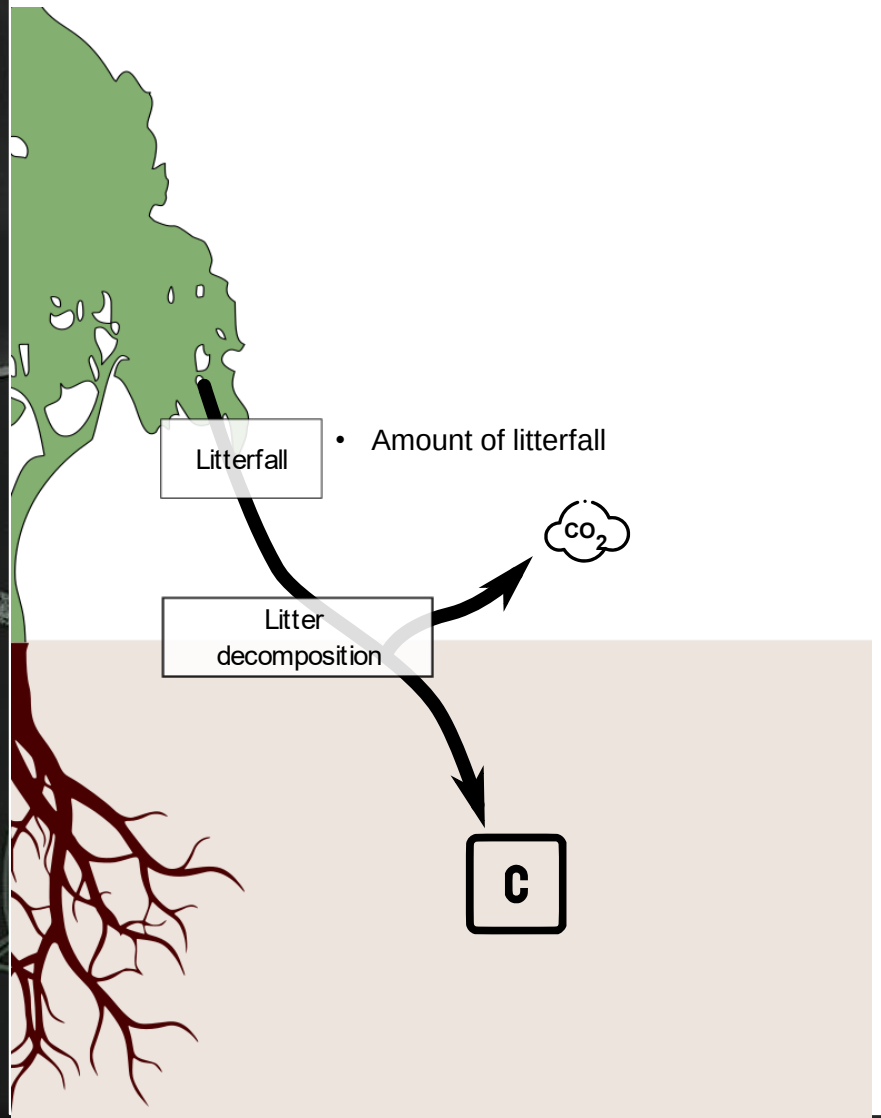
- Tree diversity enhances amount of litterfall and litter decomposition

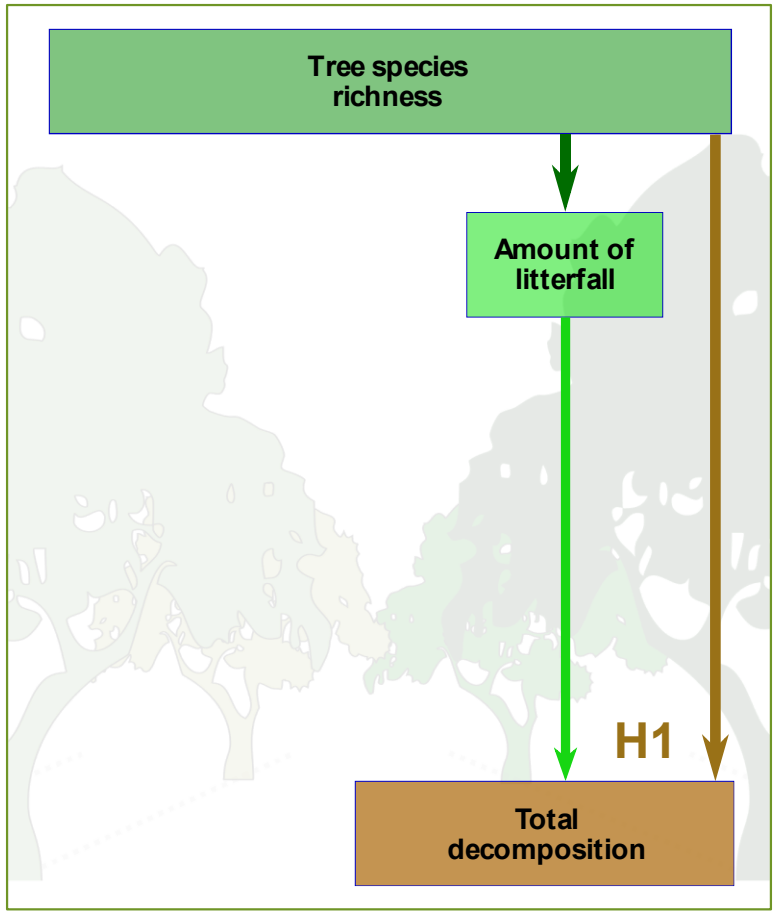


Introduction

Wardle *et al*. 2004

- Forest leaf production is integrated into soil by litter decomposition

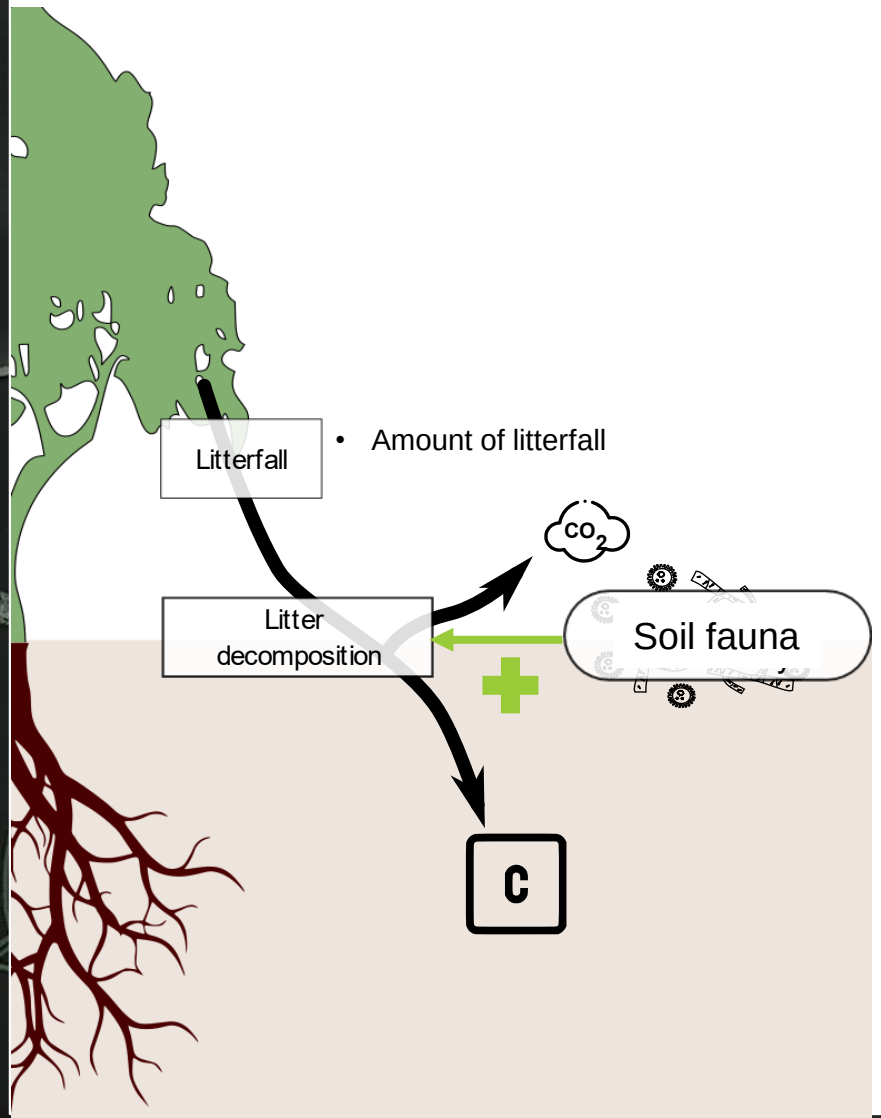




Introduction

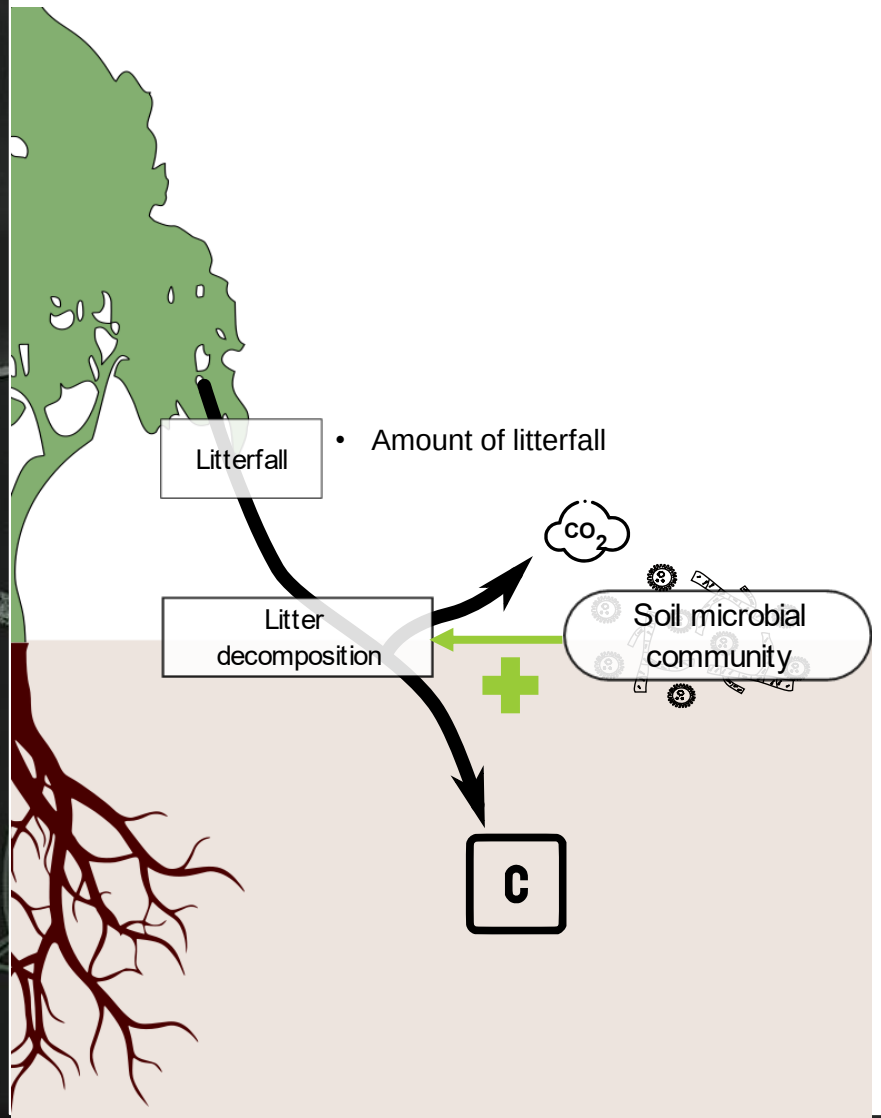
García-Palacios *et al*. 2013

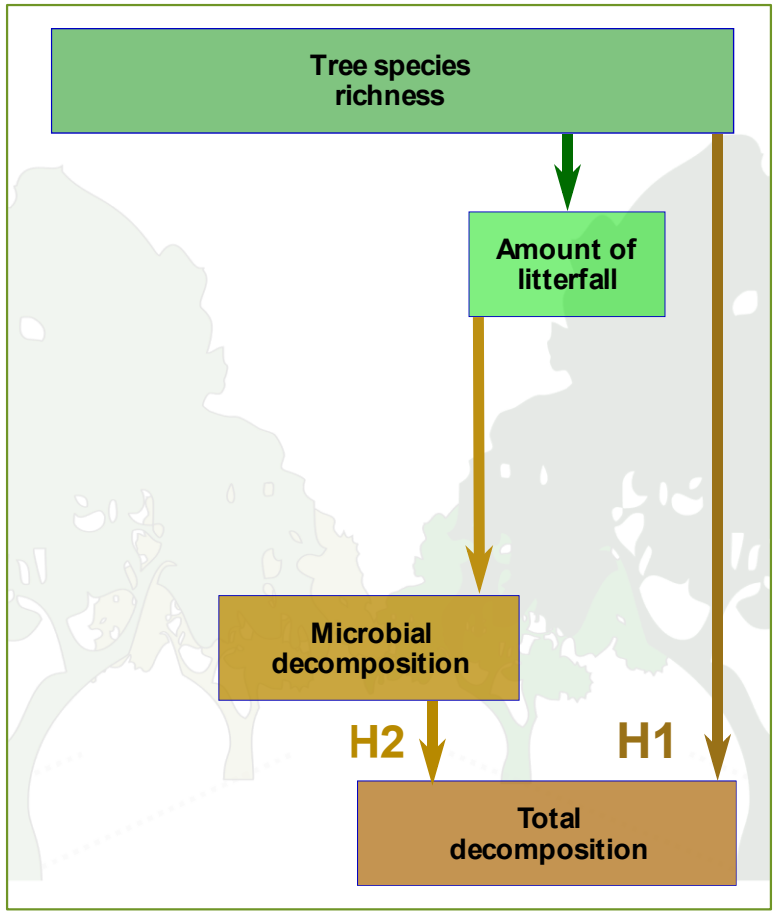
- Litter decomposition is carried out by soil fauna



Introduction

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

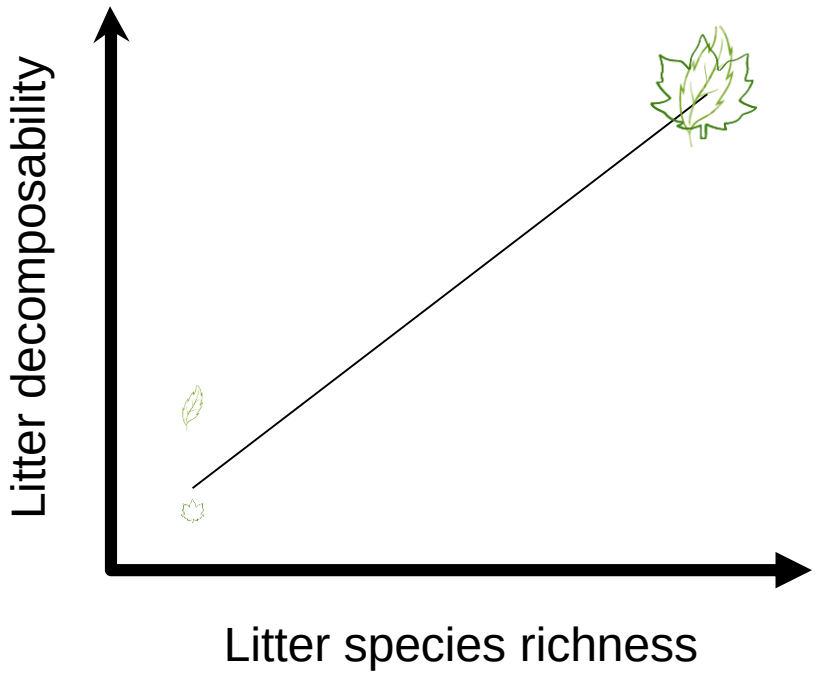




Bradford *et al*. 2002; Joly *et al*. 2018

Introduction

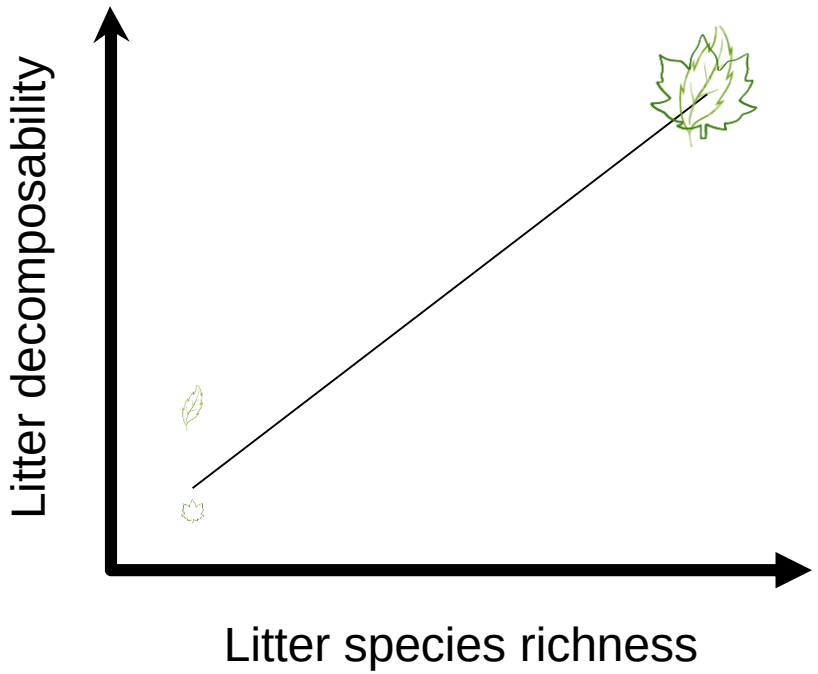
- Litter decomposability (susceptibility of litter to decomposition) increases with litter species richness

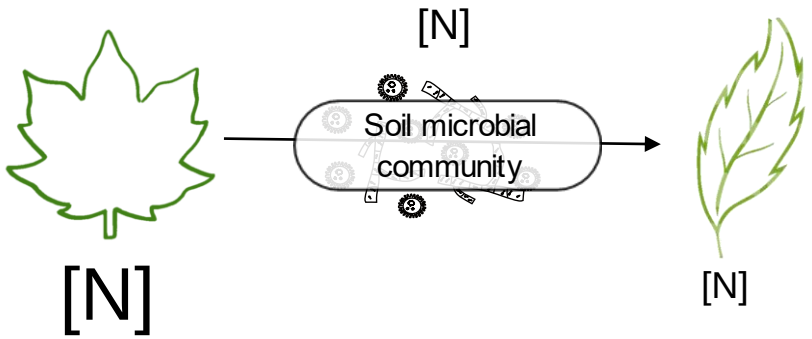


Zhou *et al*. 2020

Introduction

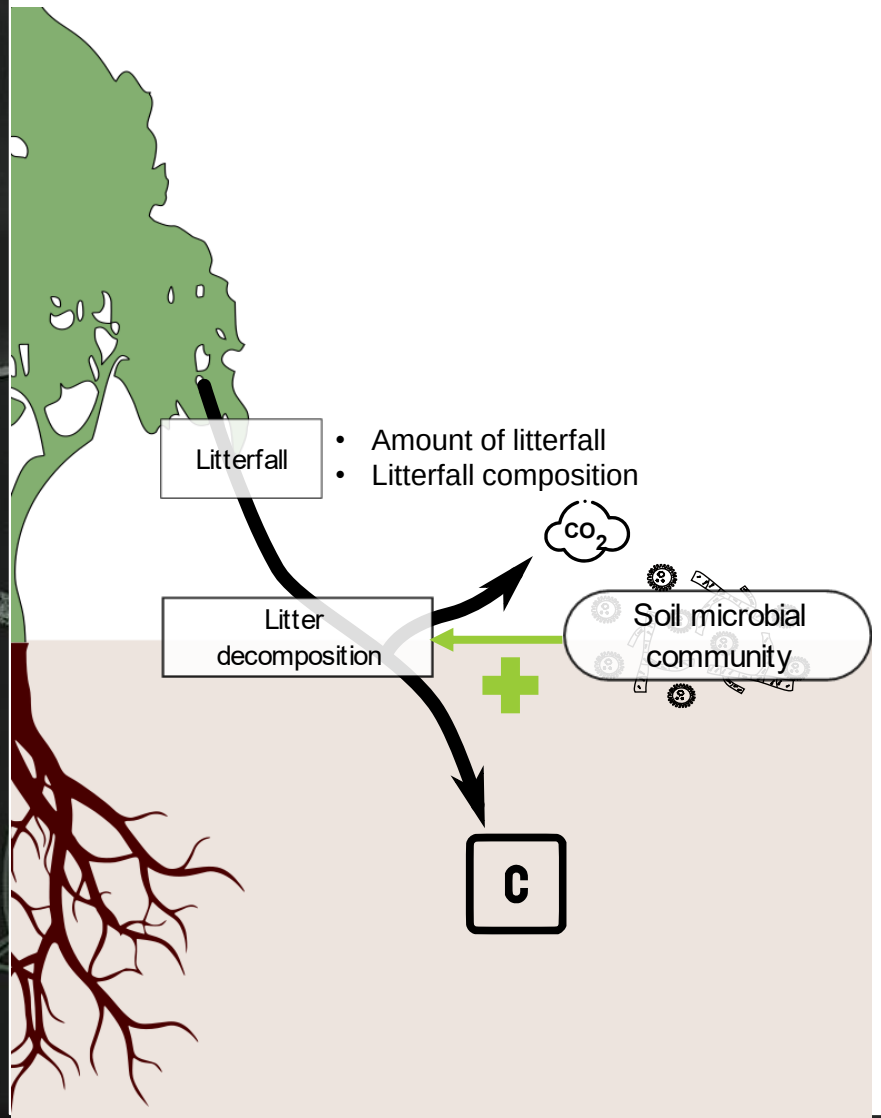
- Litter decomposability (susceptibility of litter to decomposition) increases with litter species richness

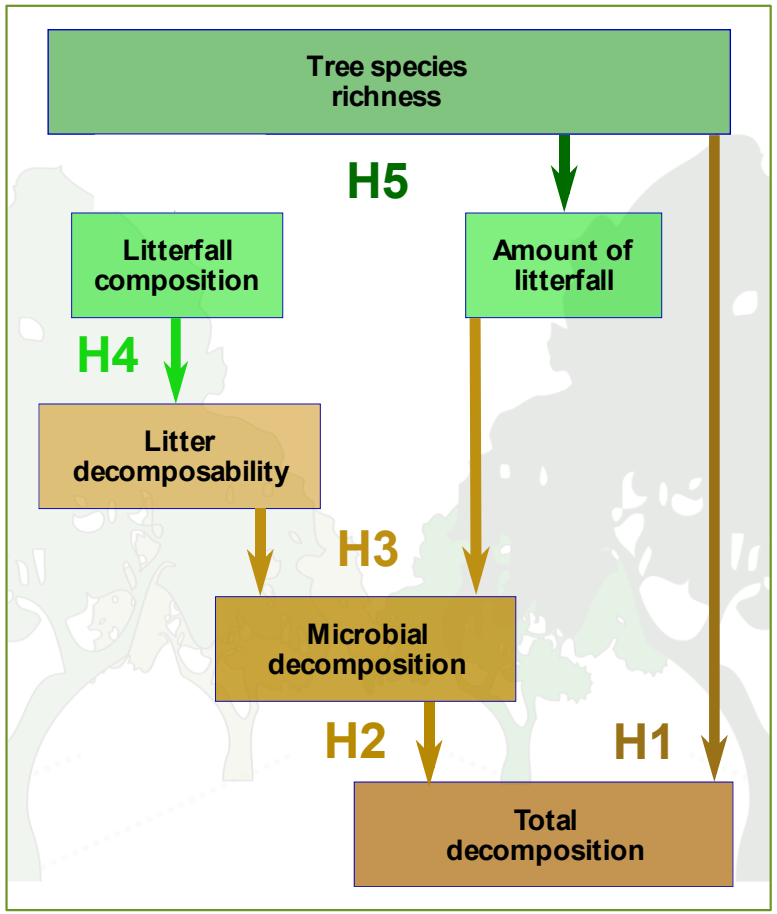




Hättenschwiler *et al*. 2005

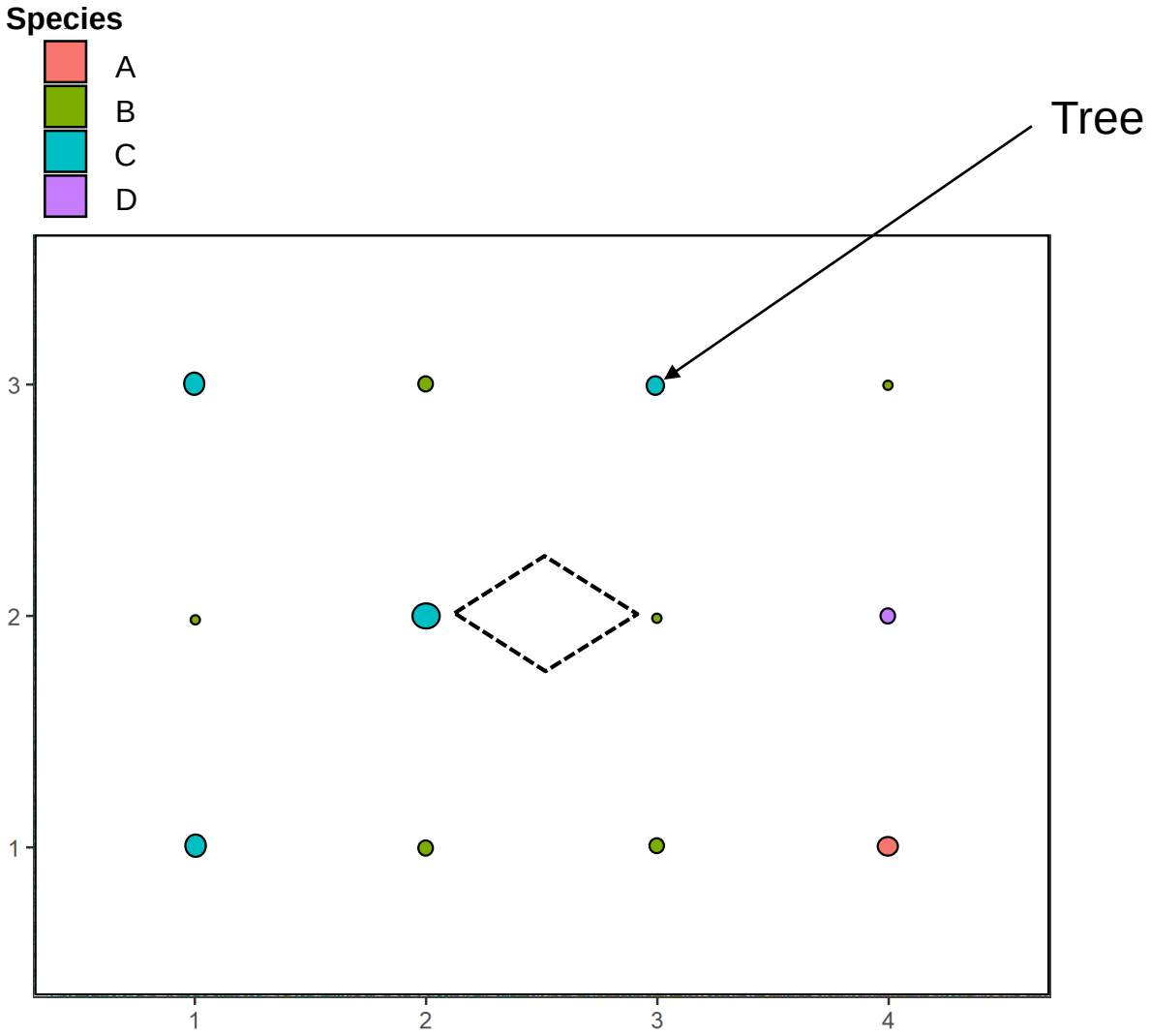
Introduction





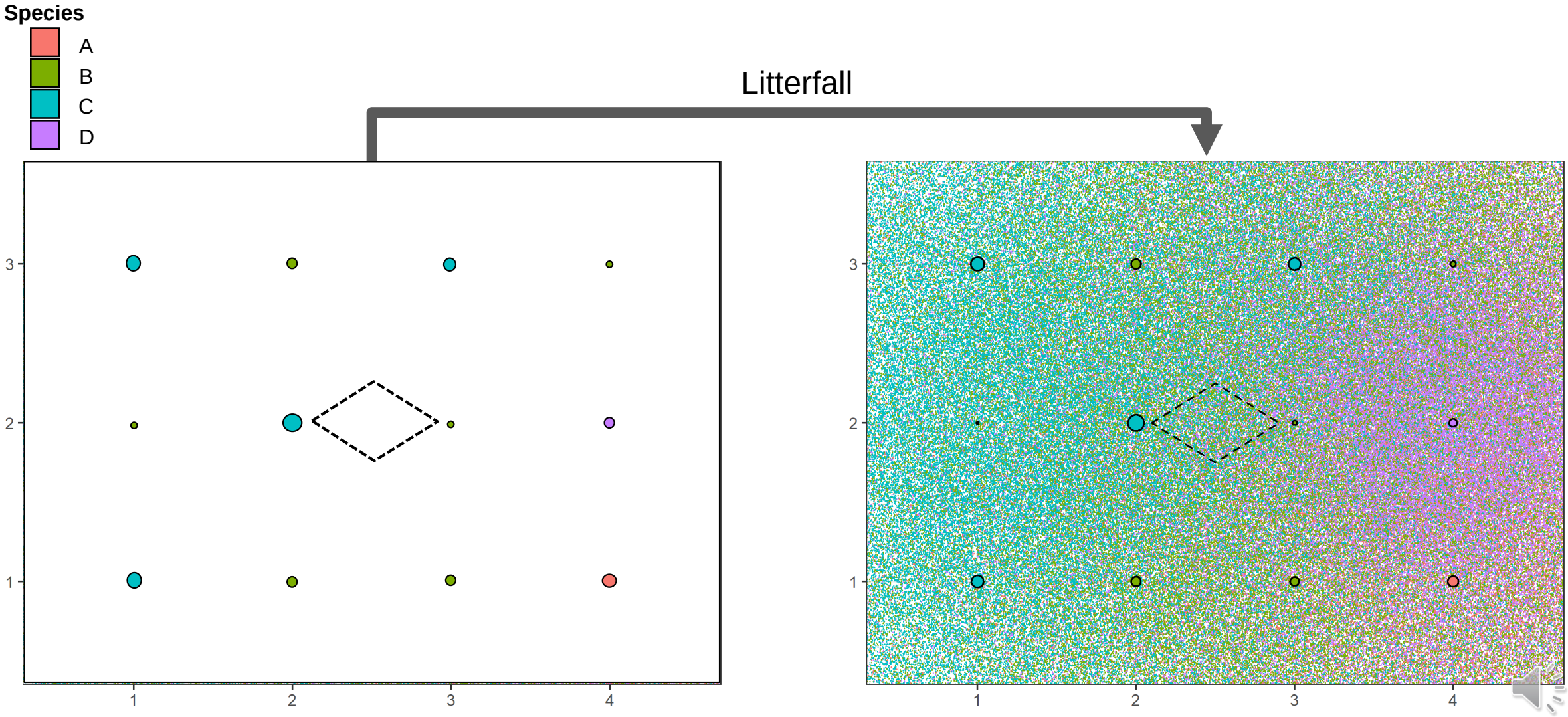
Introduction

- Identifying the drivers of litterfall spatial distribution



Introduction

- What are the drivers of litterfall and how do they mediate tree species richness?



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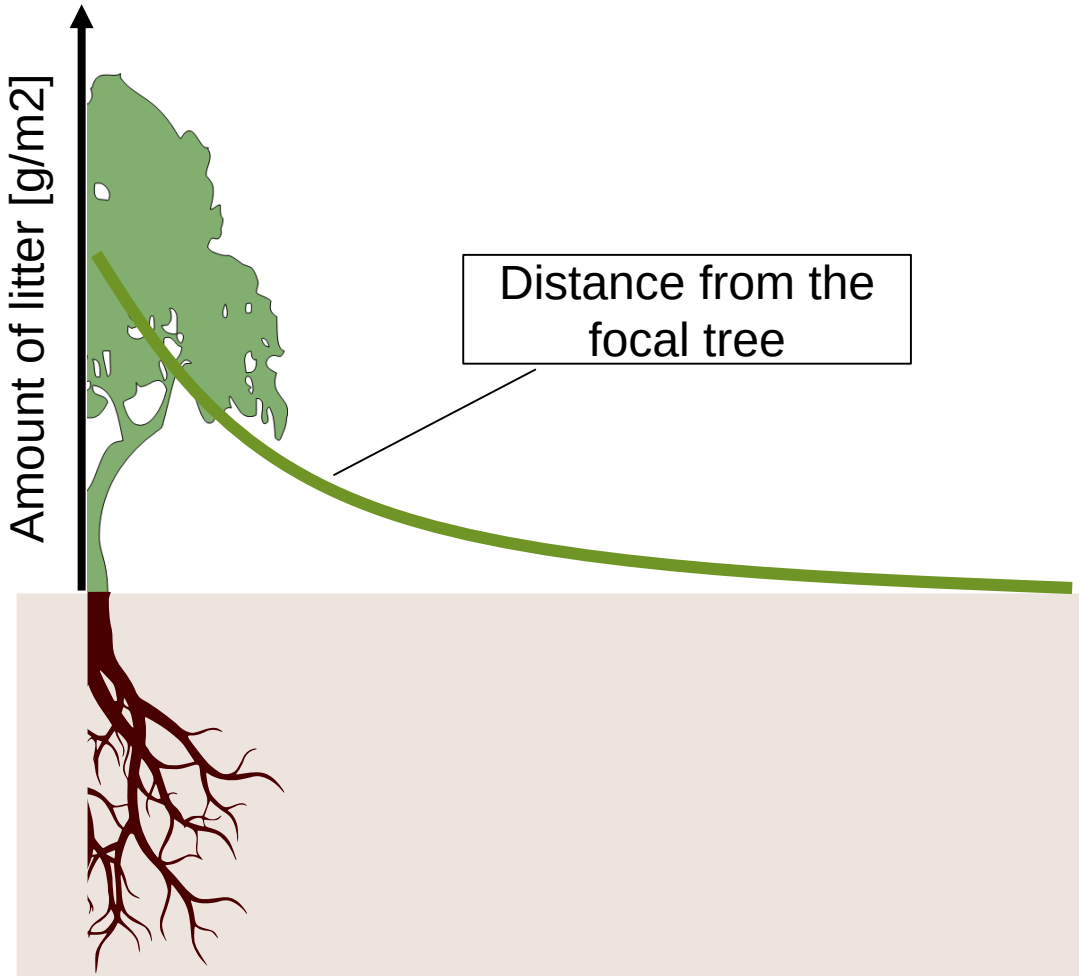

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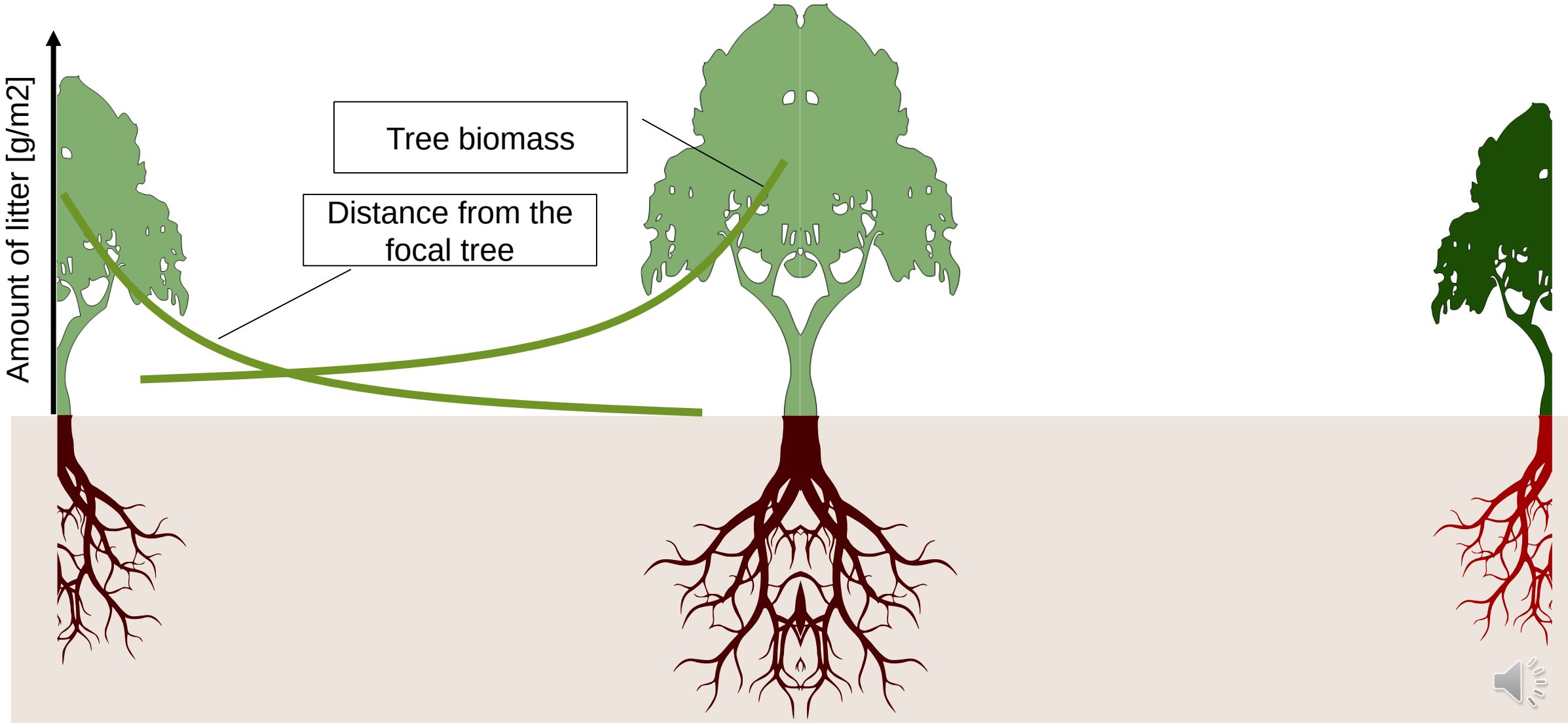

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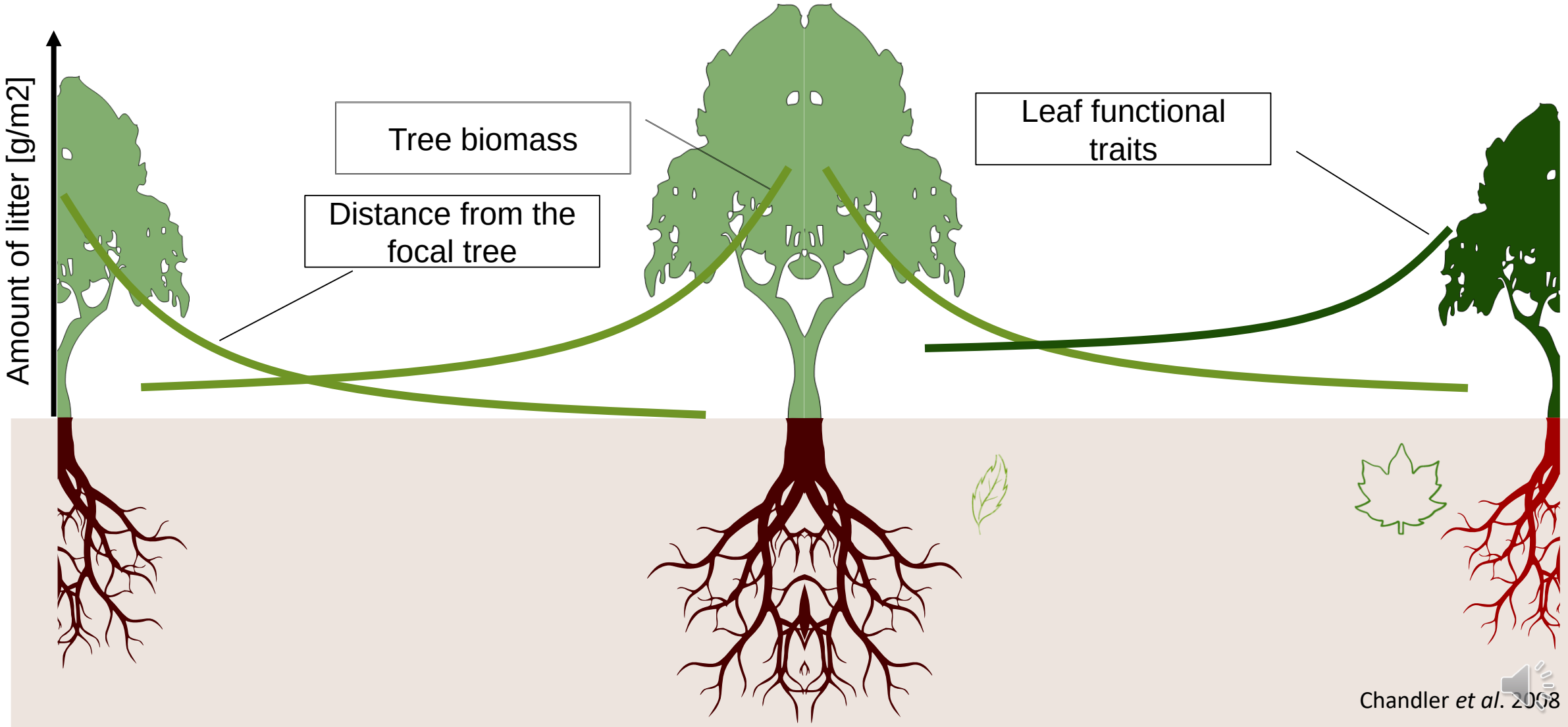
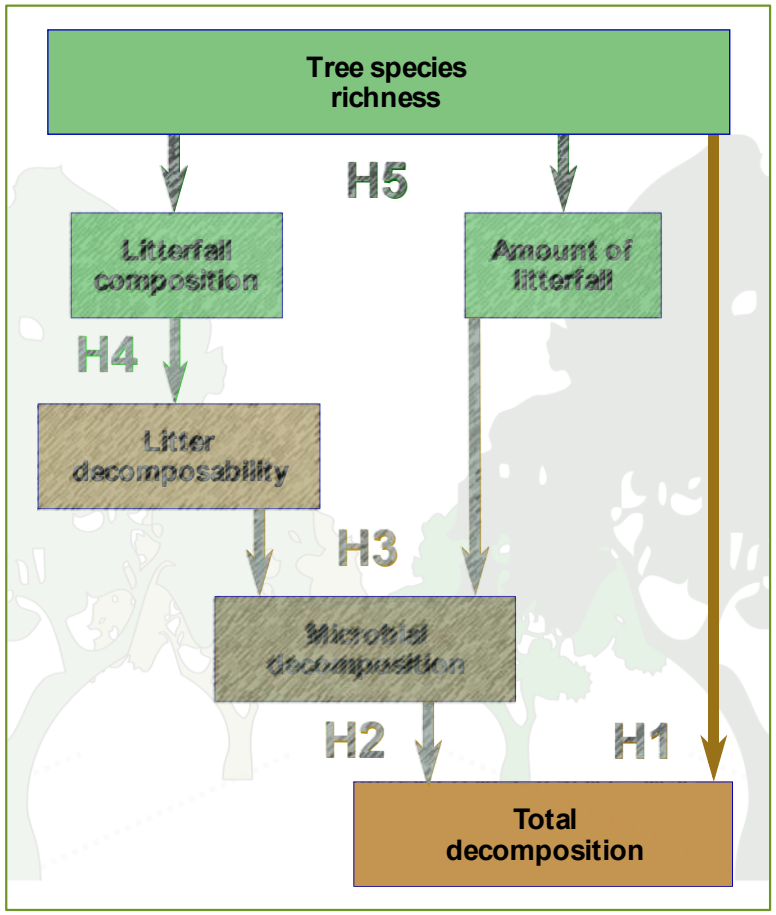


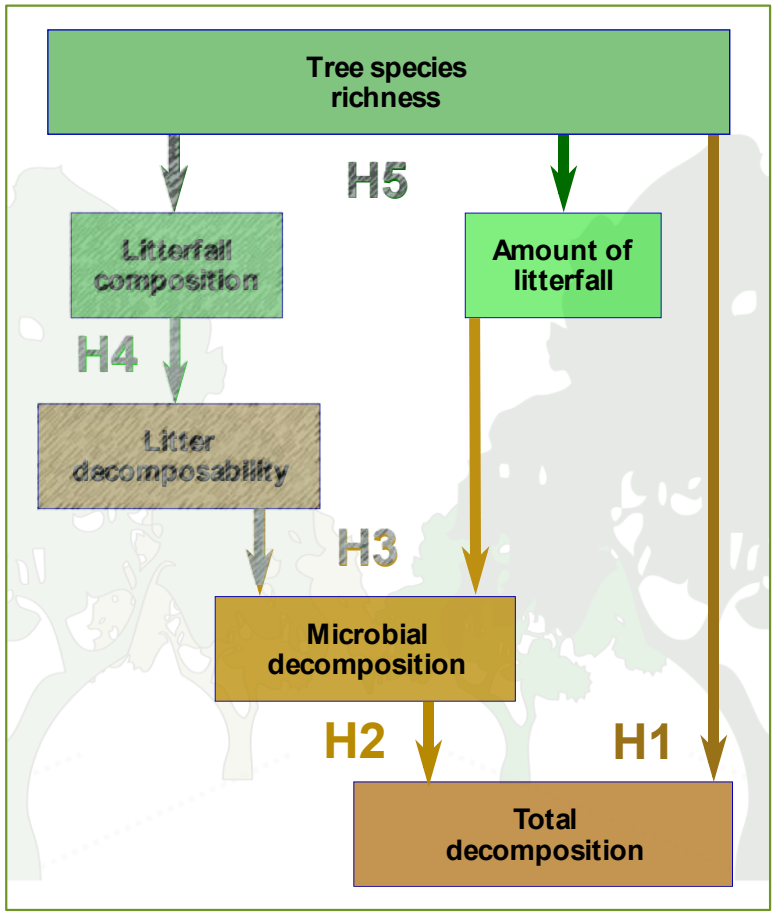
Chandler *et al*. 2008

Introduction



H1 - tree species richness increases litter decomposition

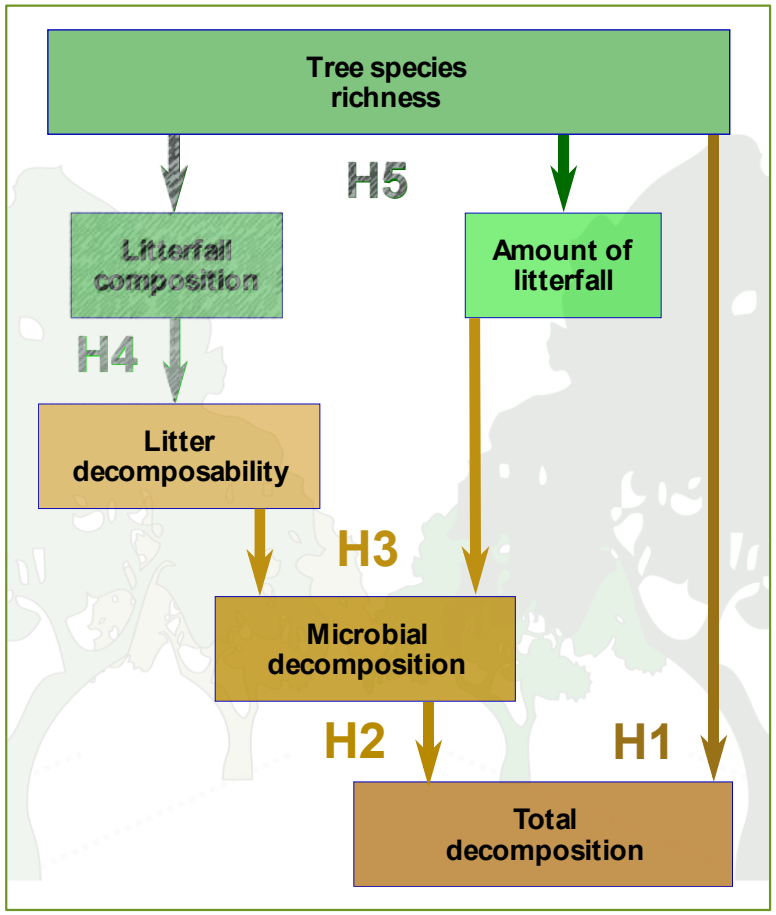
Introduction



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

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

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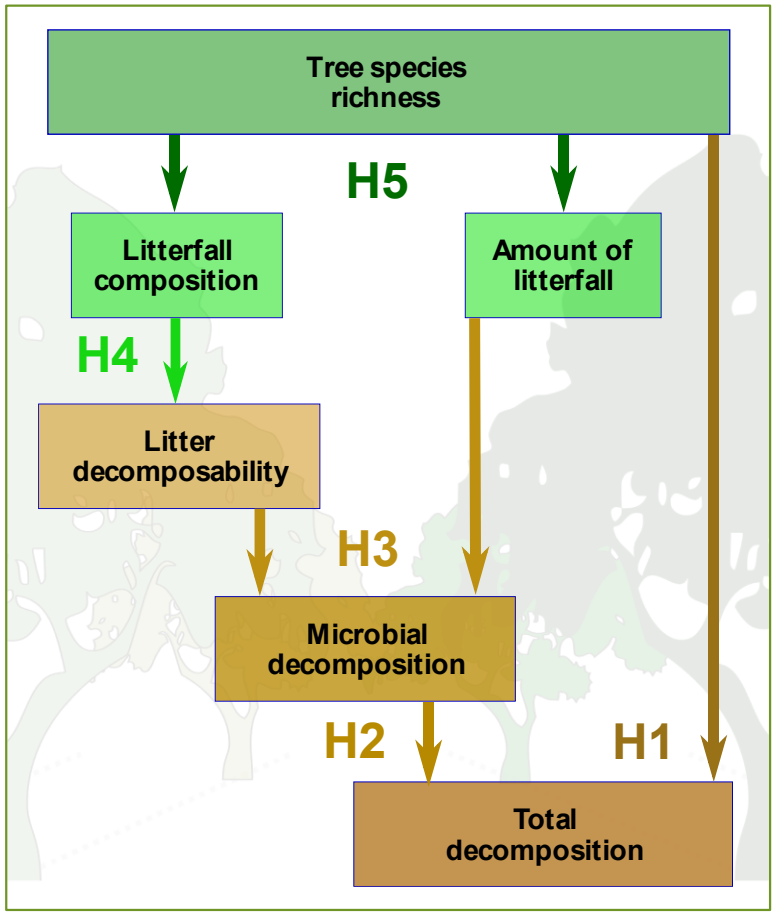

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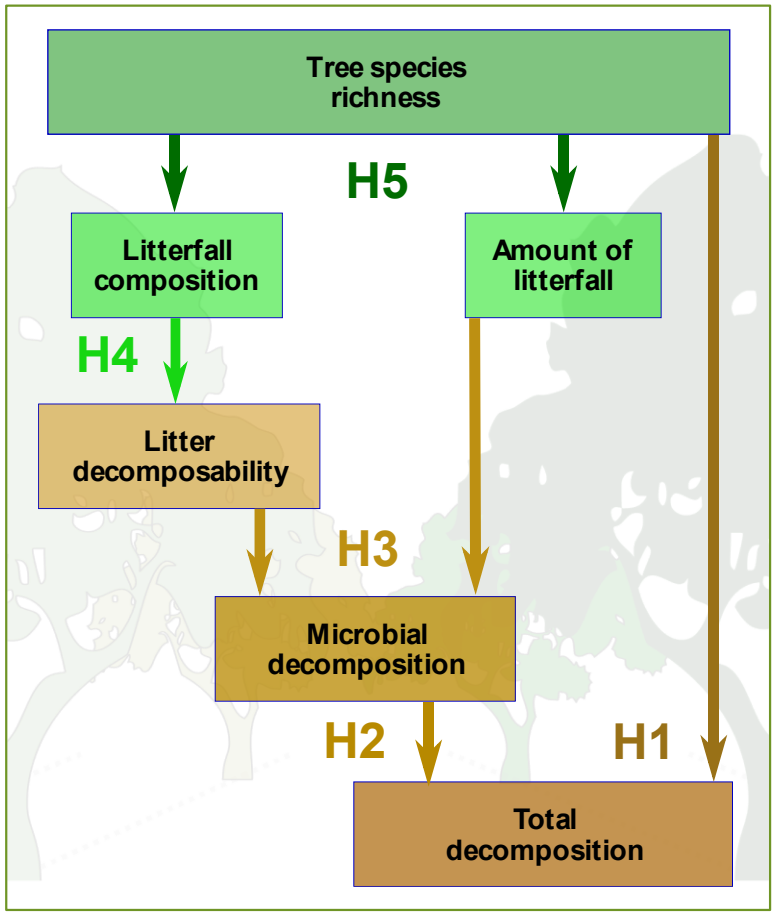
H4 - litter species richness and functional traits increase litter decomposability

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 - the spatial distribution of litter is driven by tree biomass, leaf functional traits, and the spatial distribution of the trees in the plot

Methods

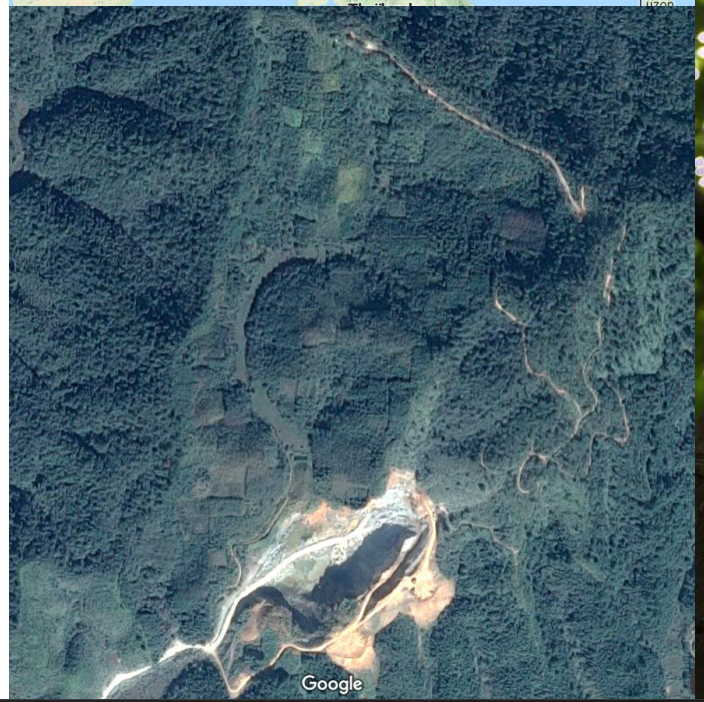
South-East China

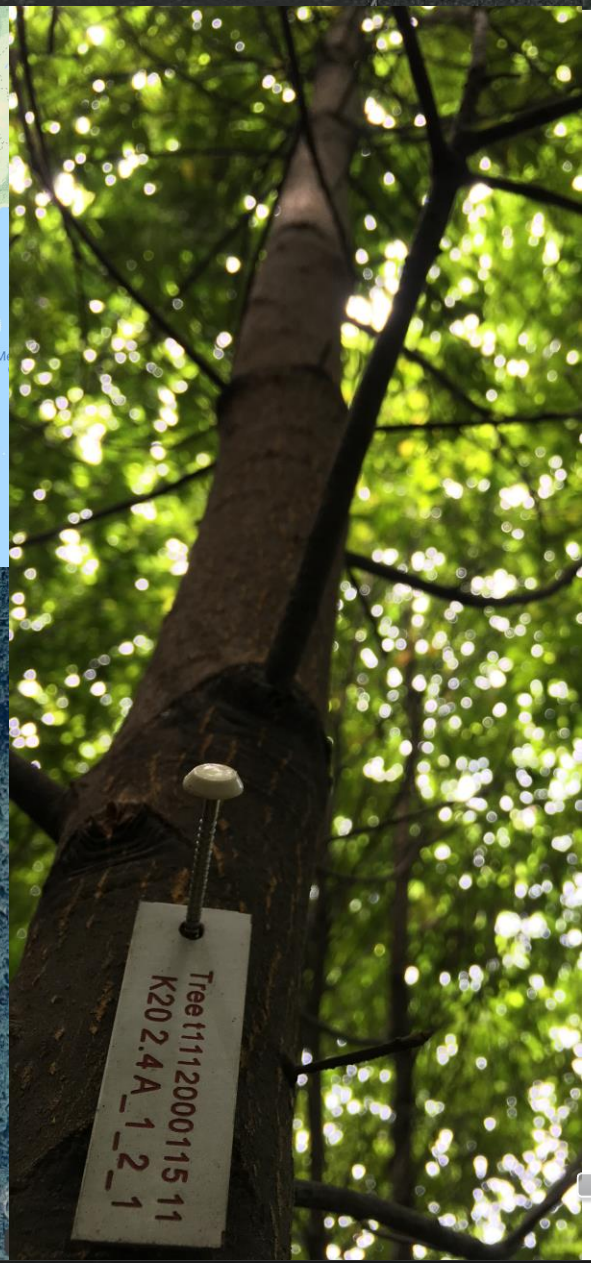
Subtropical climate: warm, rainy summers & cool, dry winters

BEF China plateform:

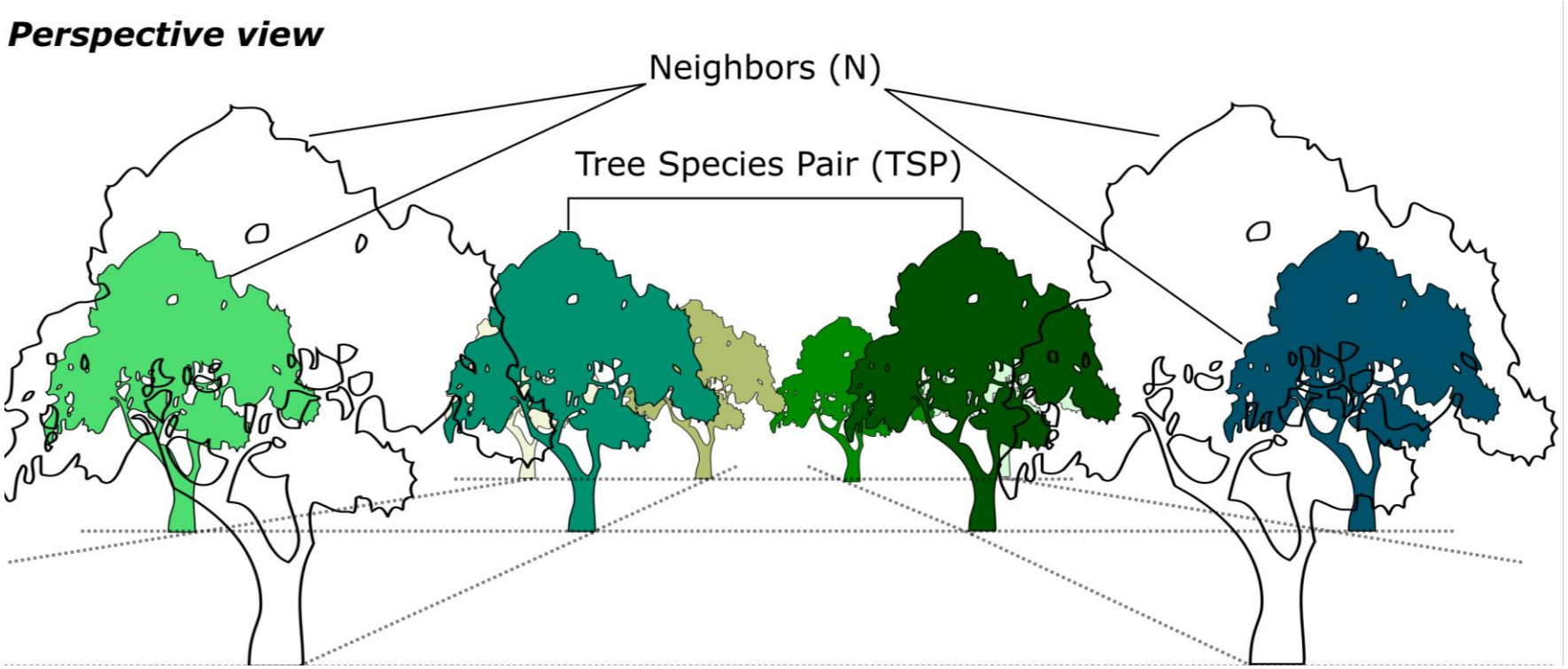
Tree diversity experiment (since 2009)

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

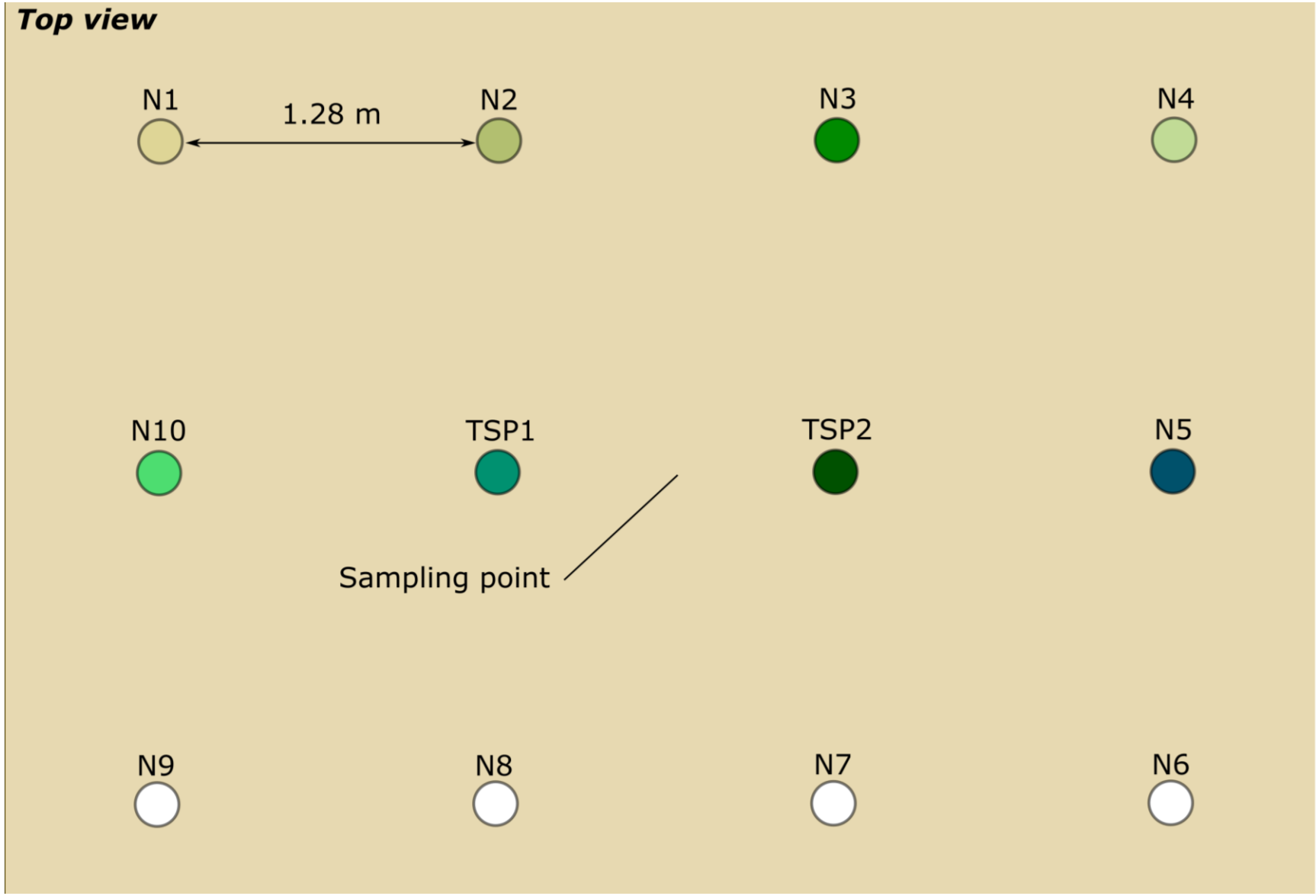




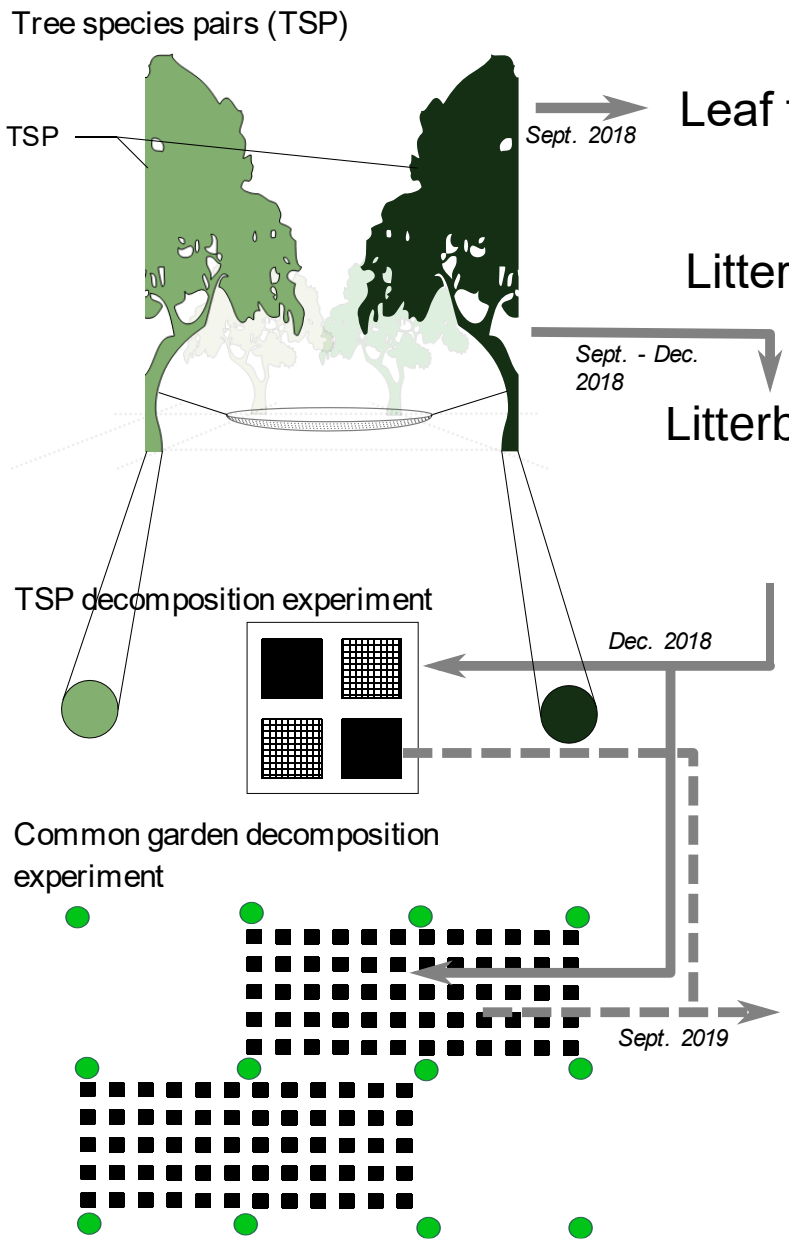
Experimental design



Experimental design



Sampling & measurements

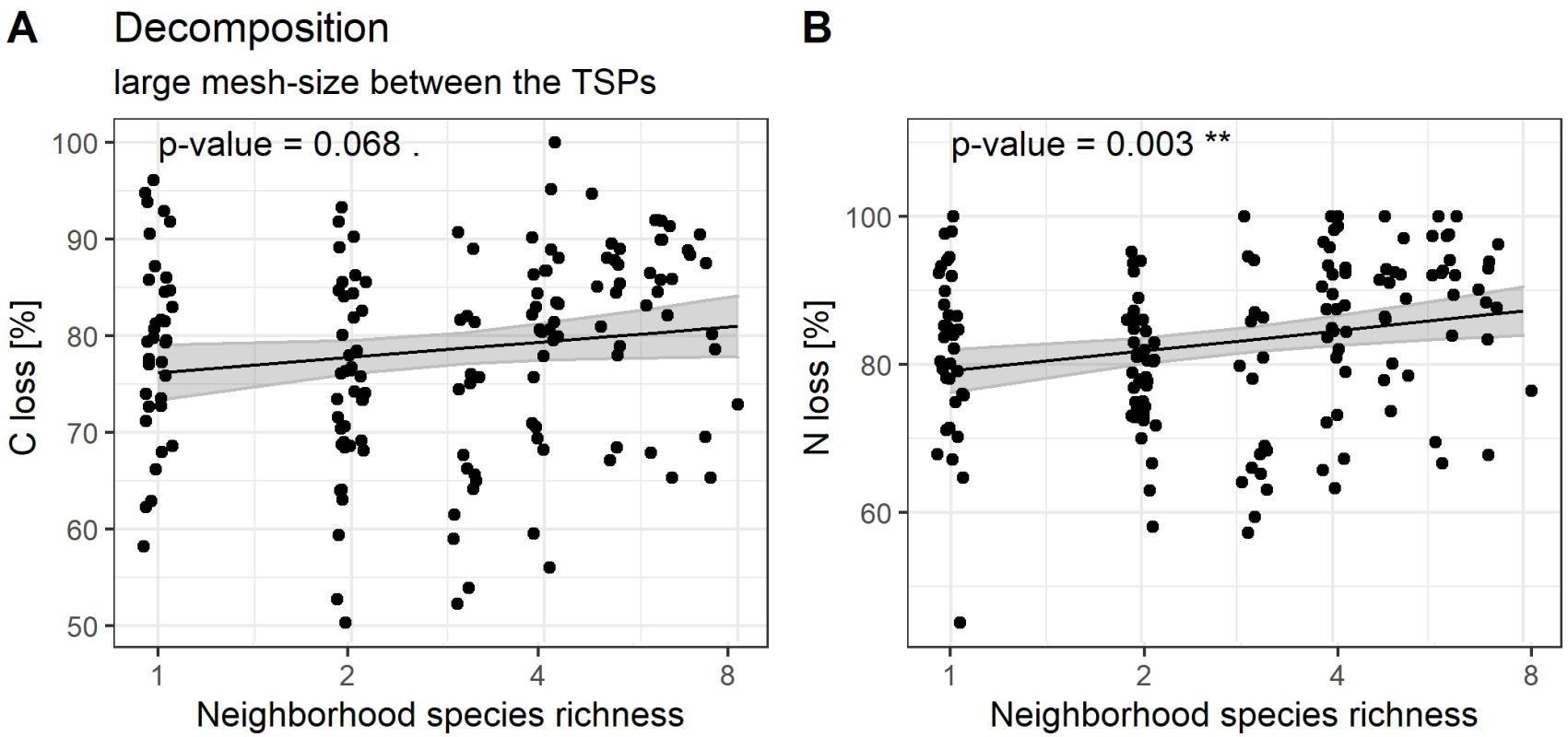


Total decomposition: 5 mm-mesh between the TSPs

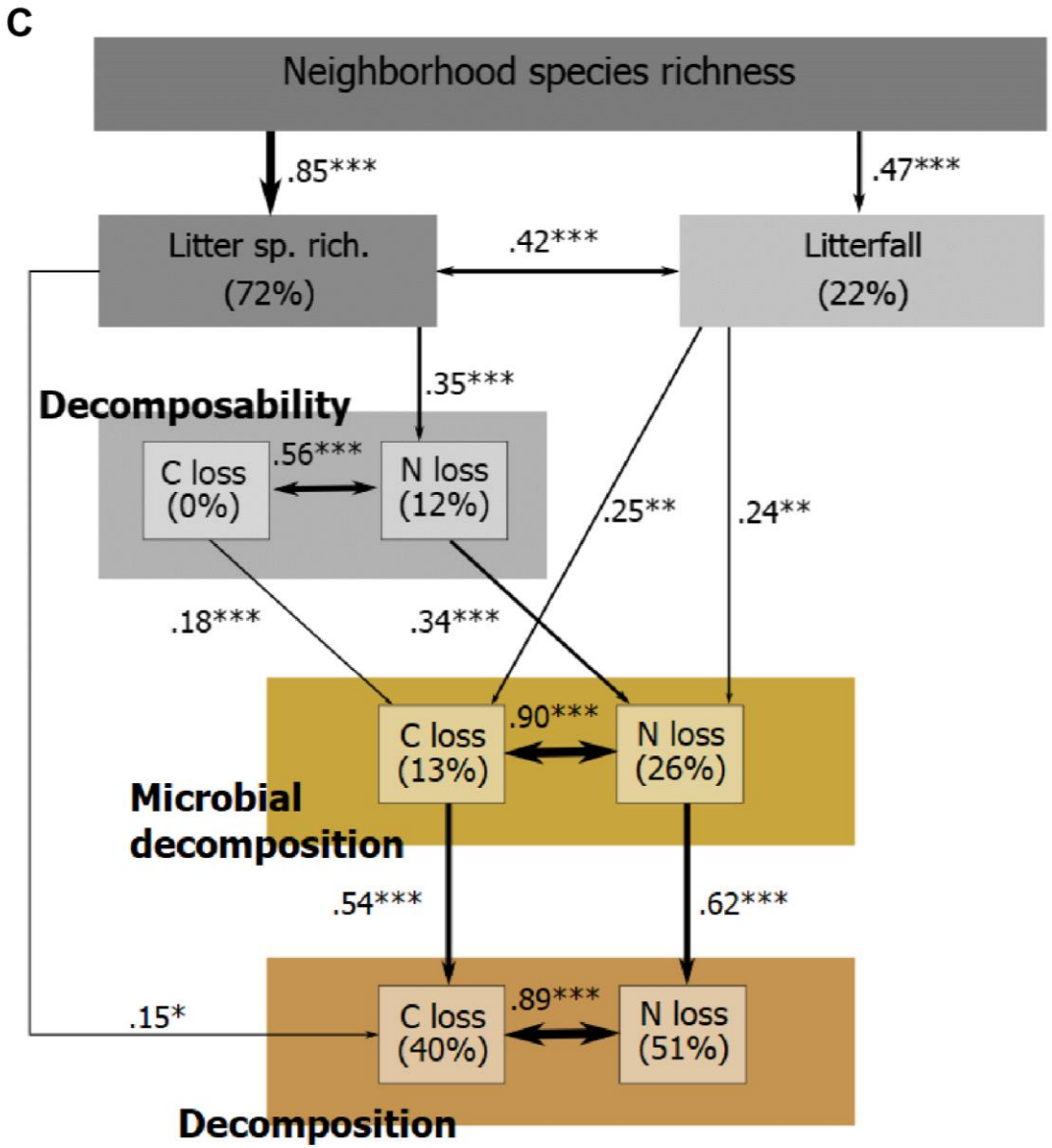
Microbial decomposition: 0.054 mm-mesh between the TSPs

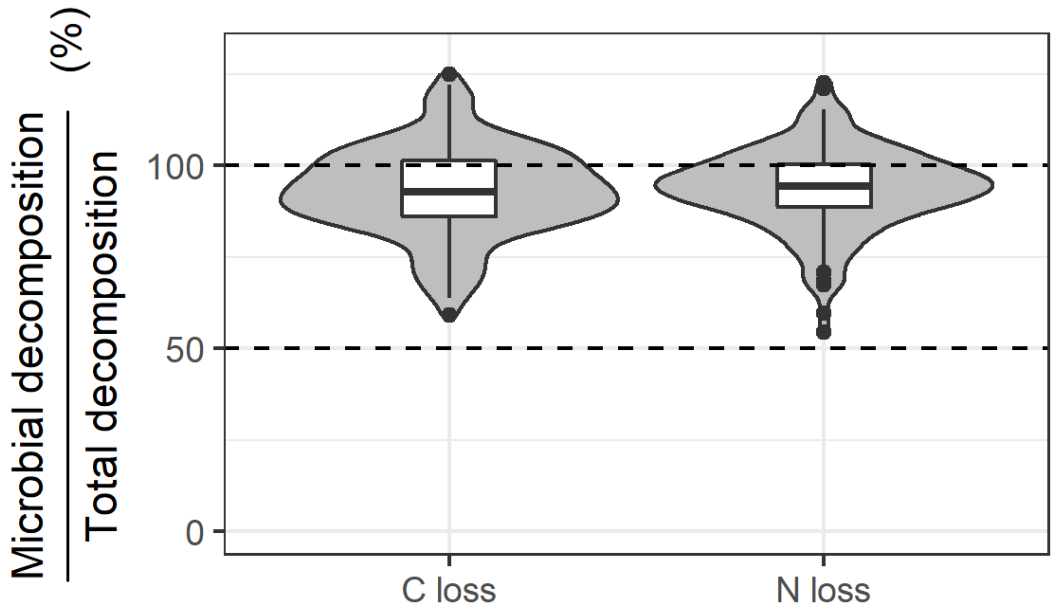
Litter decomposability: 0.054 mm-mesh in the Common Garden experiment (monoculture of *Shima Superba*)

Results: tree species richness increased decomposition

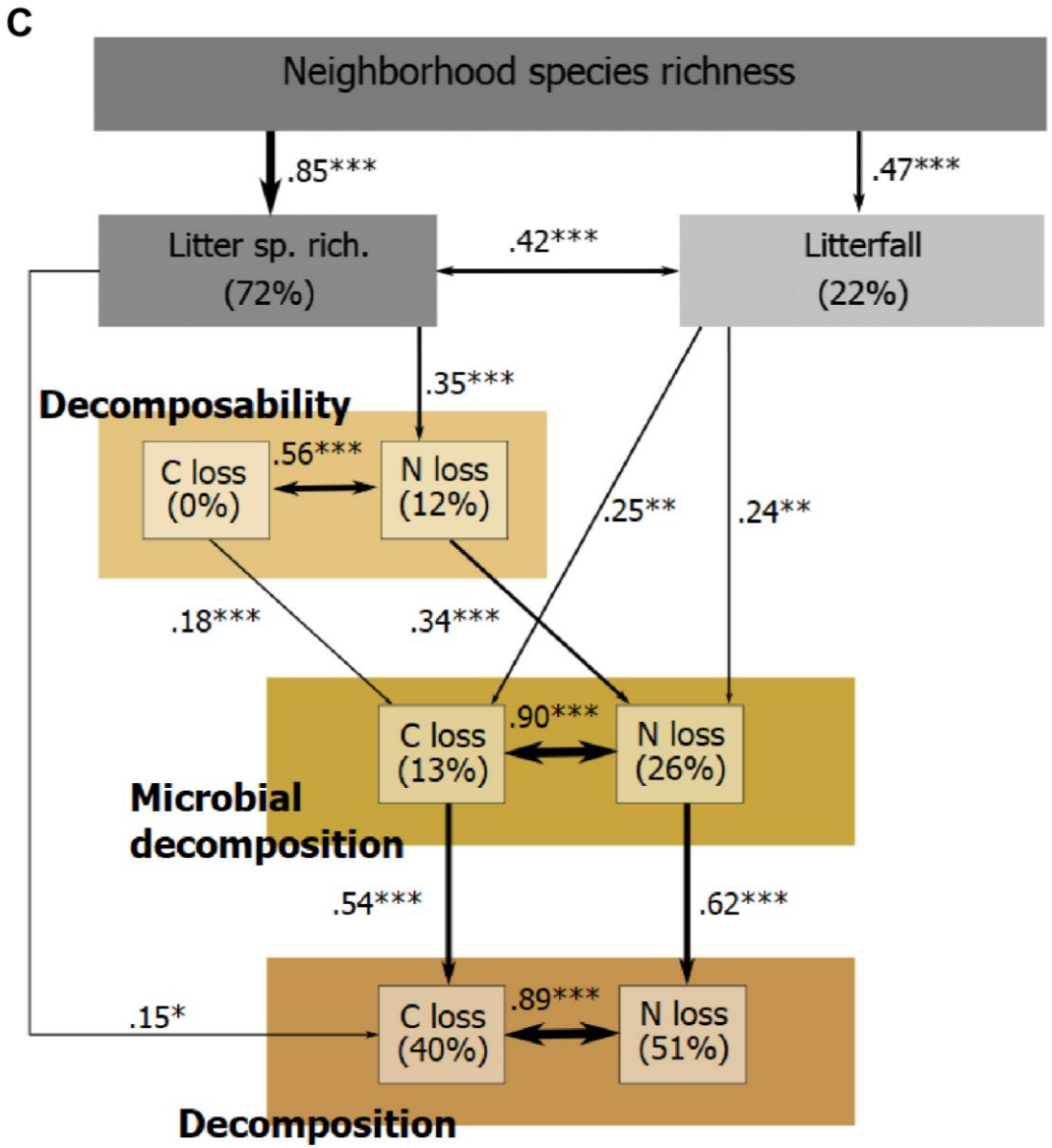


Results: litter decomposition was mostly carried by the microbial community

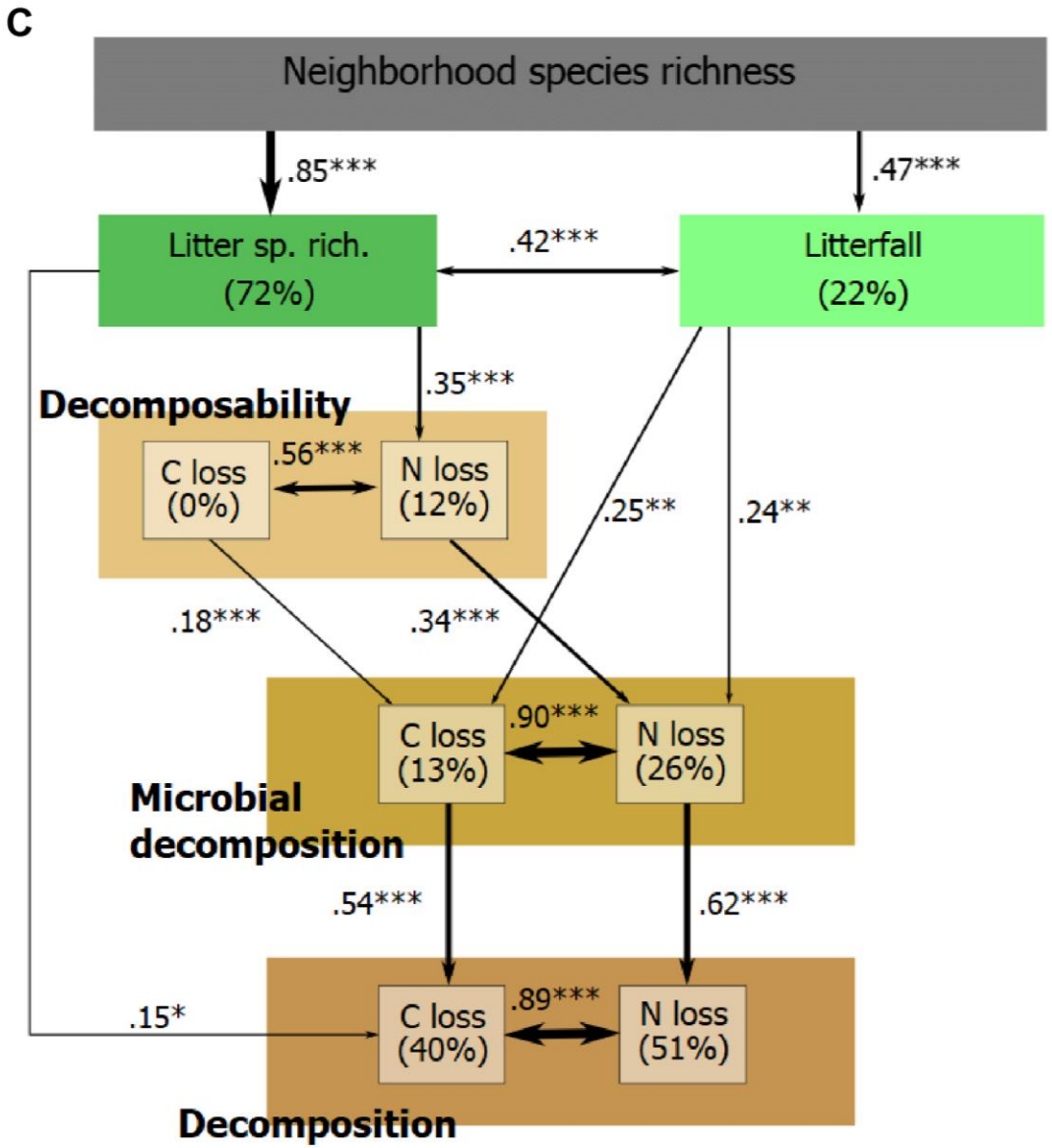




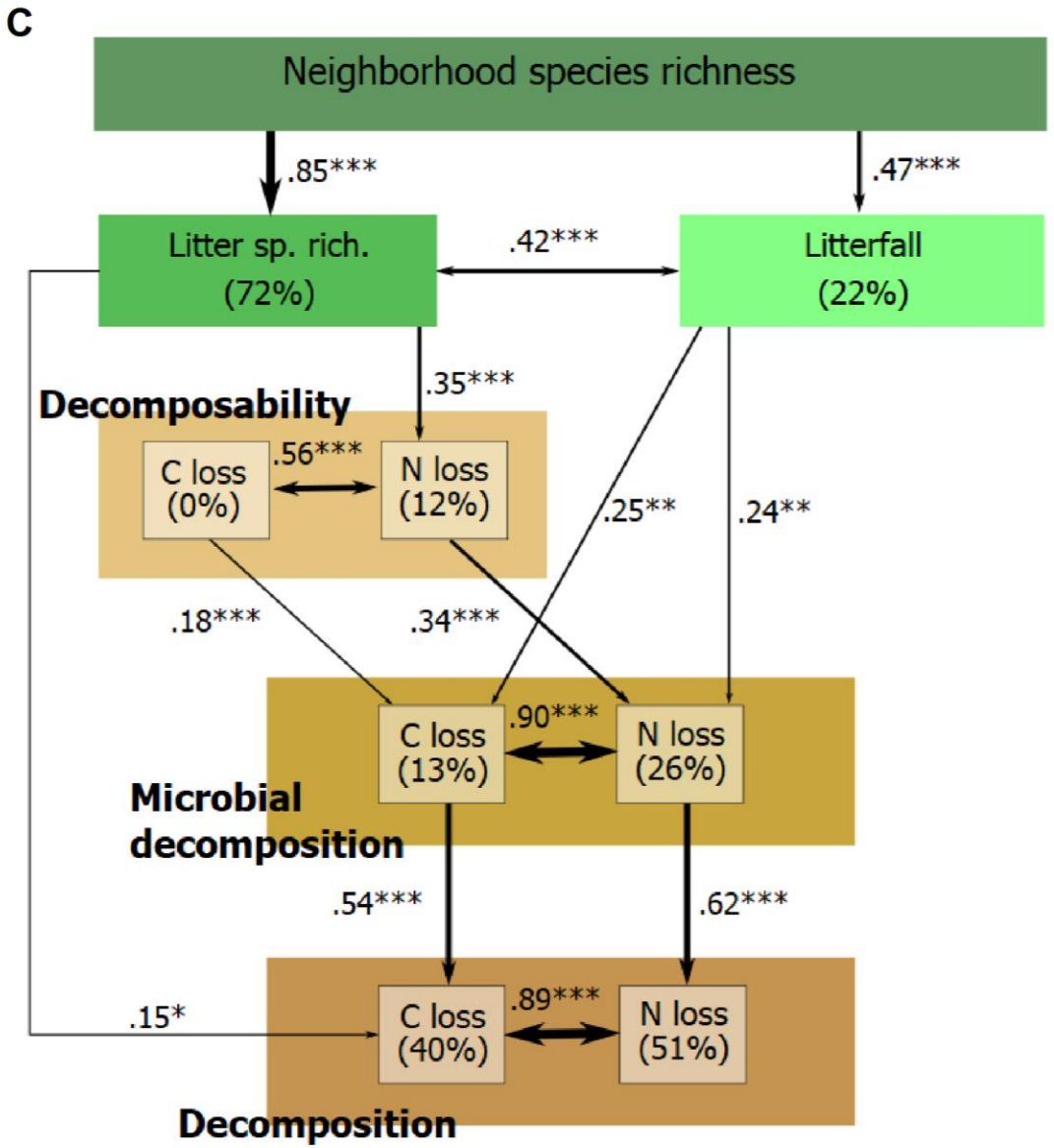
Results: litter decomposition increased with litter decomposability

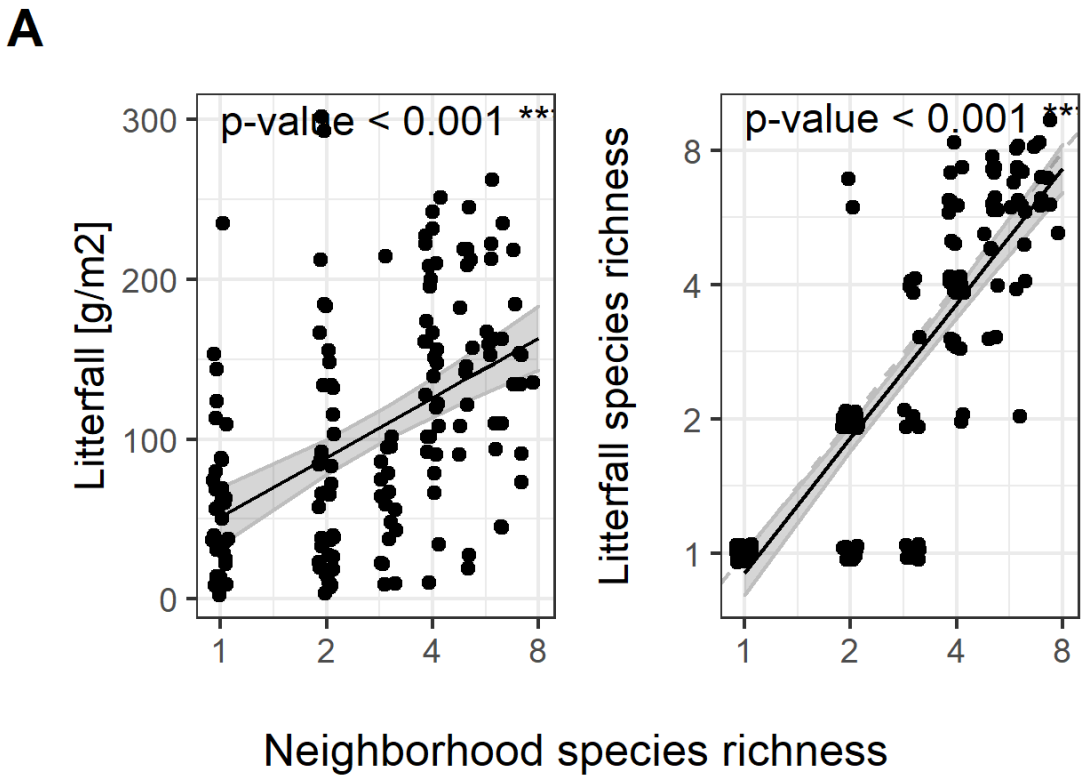


Results: amount and species richness of the litterfall enhanced decomposition

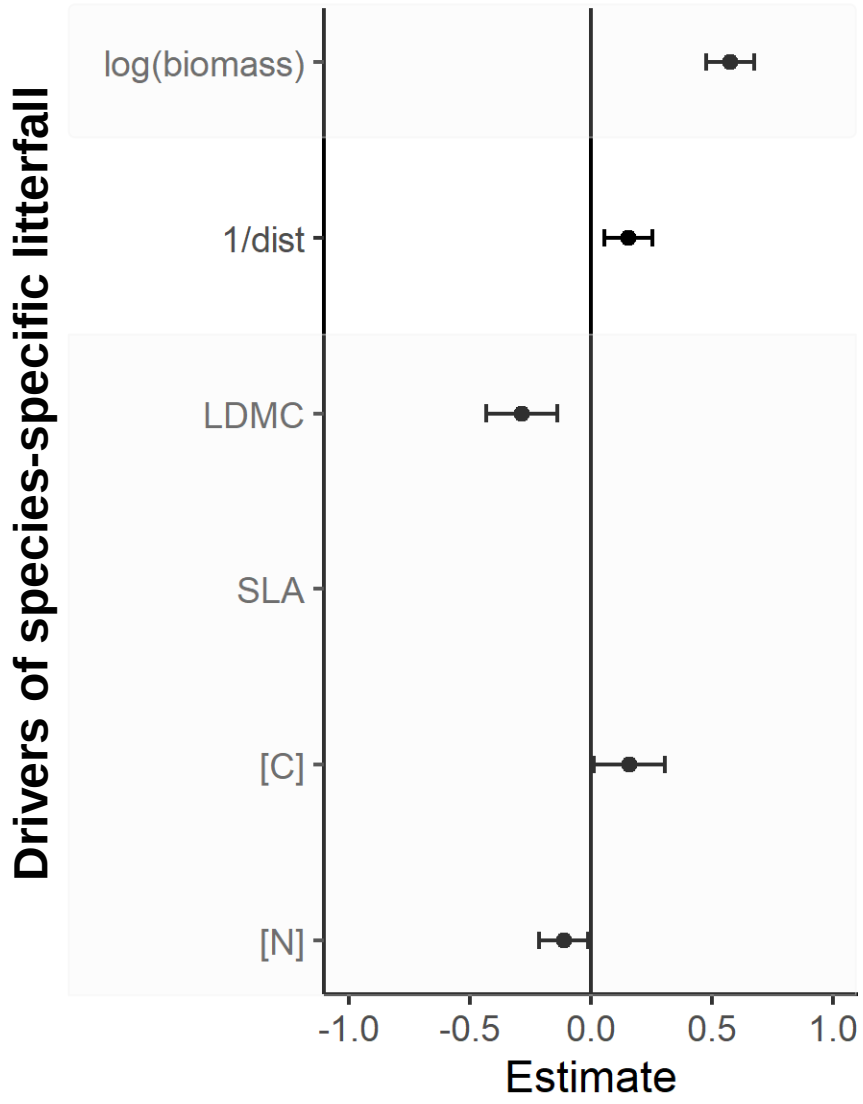


Results: tree species richness increased both amount and diversity of litterfall

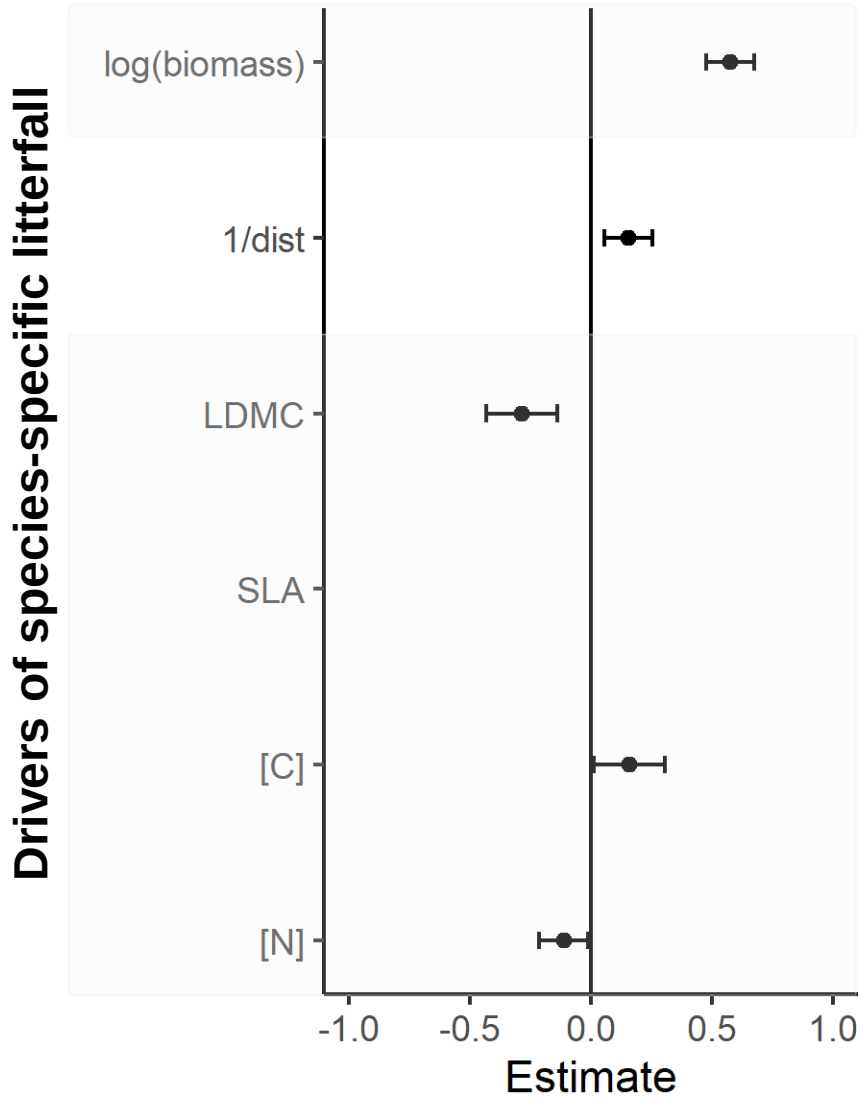




Results

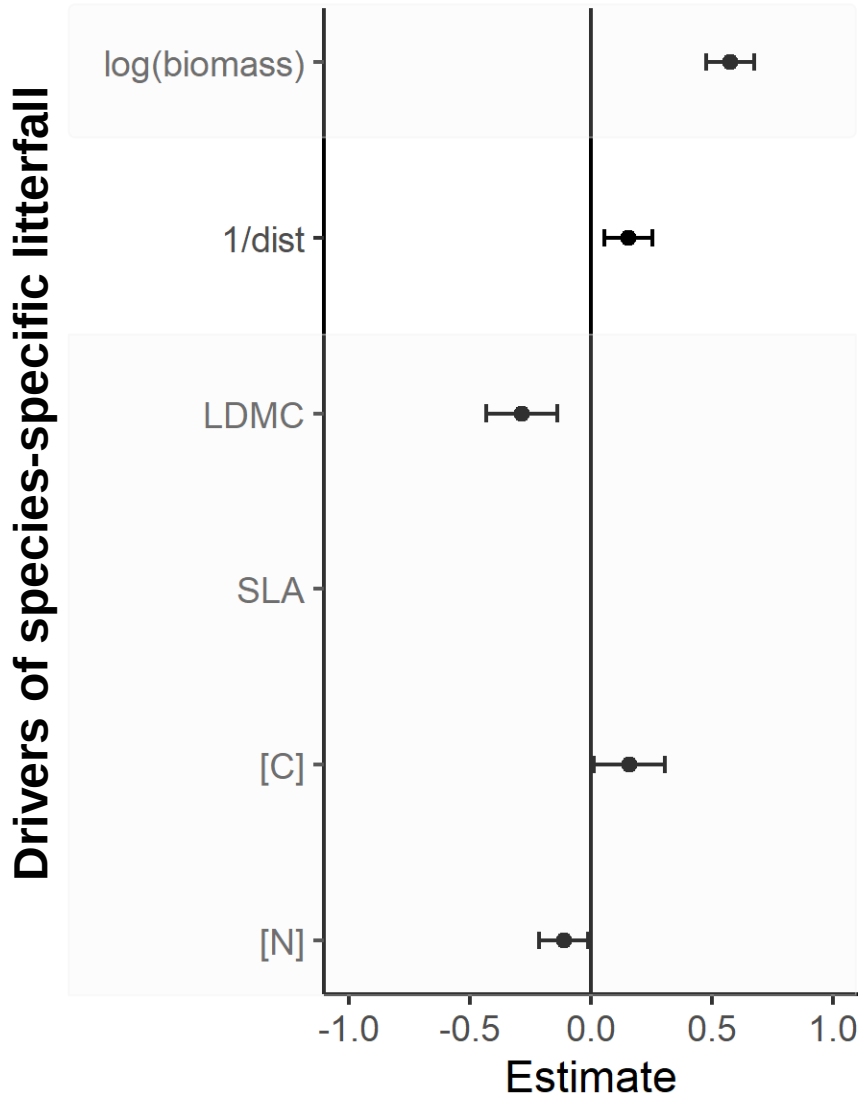

Drivers of species-specific litterfall
log(biomass)
1/dist
LDMC
SLA
[C]
[N]
-1.0
-0.5
0.0
0.5
1.0
Estimate

Results



Tree biomass effect

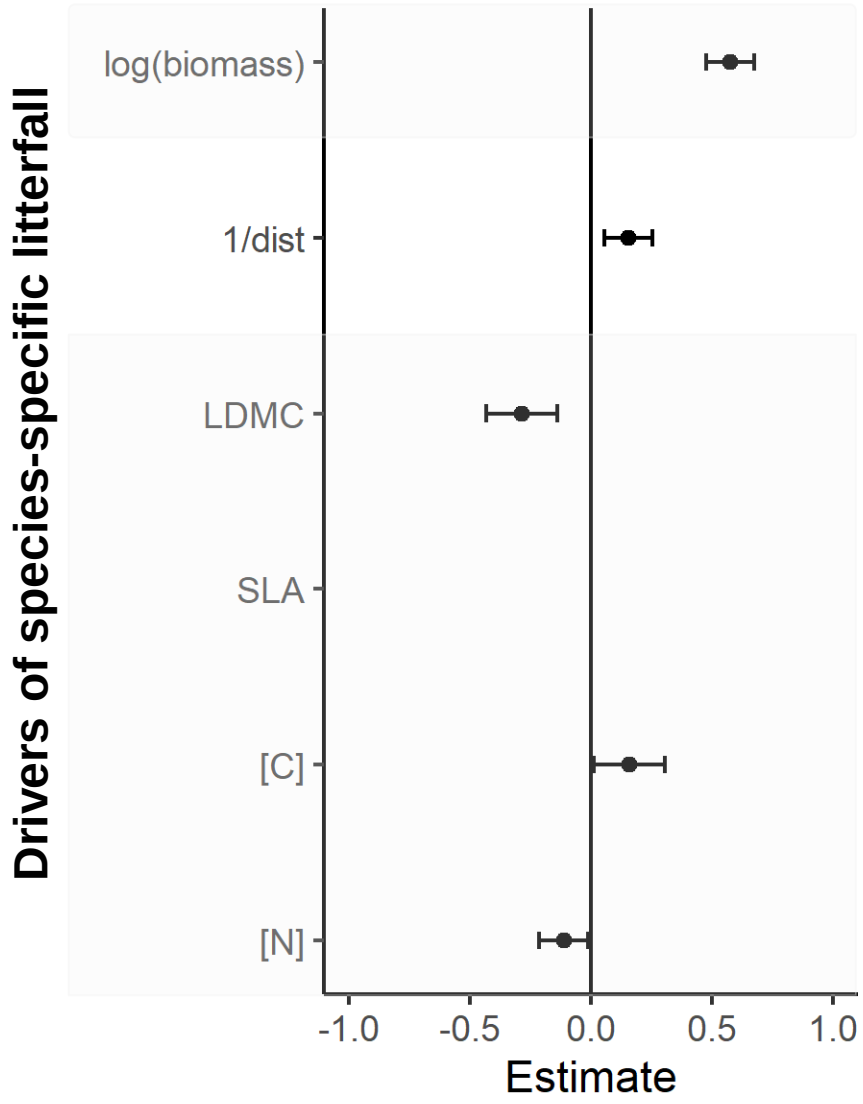
Results



Tree biomass effect

Tree spatial distribution effect

Results

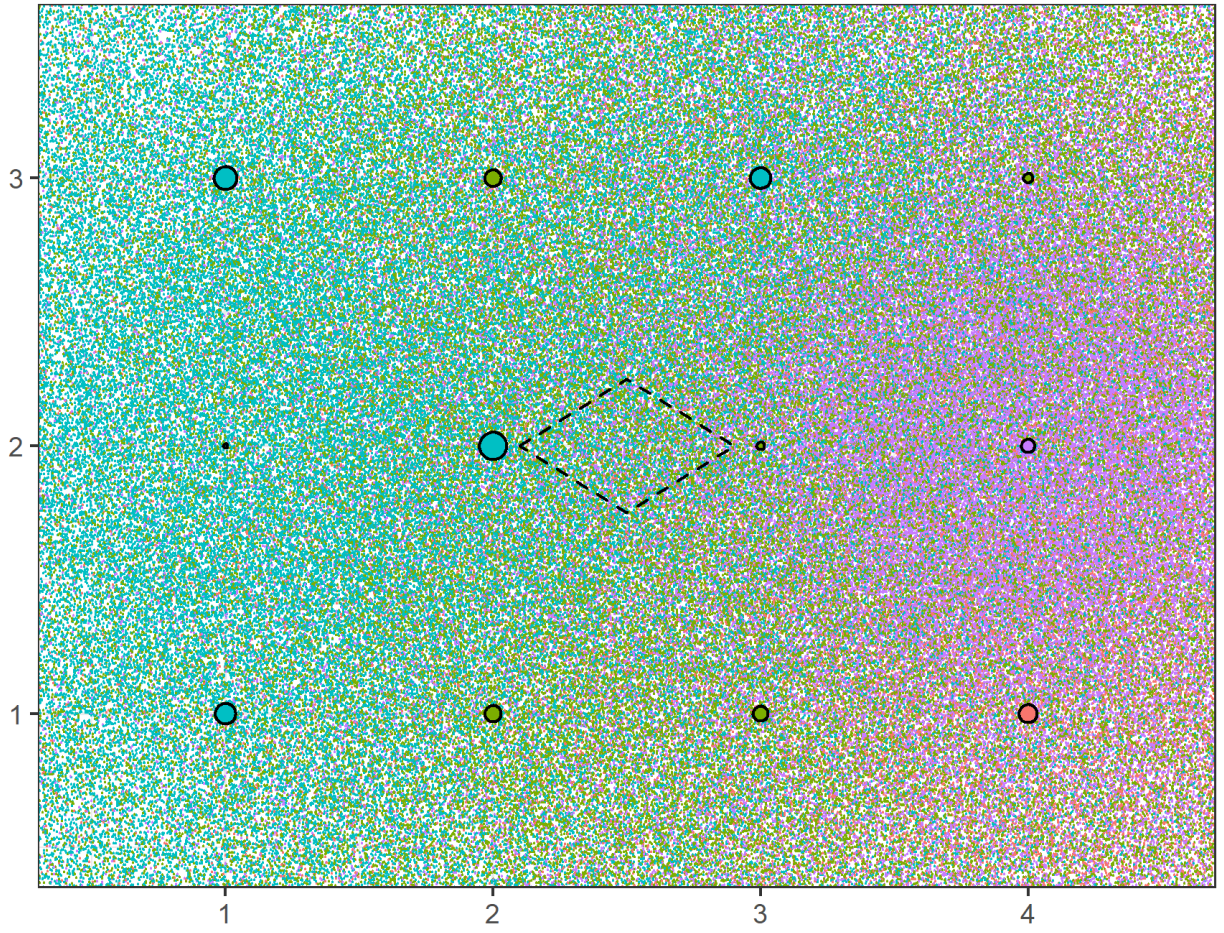


Tree biomass effect

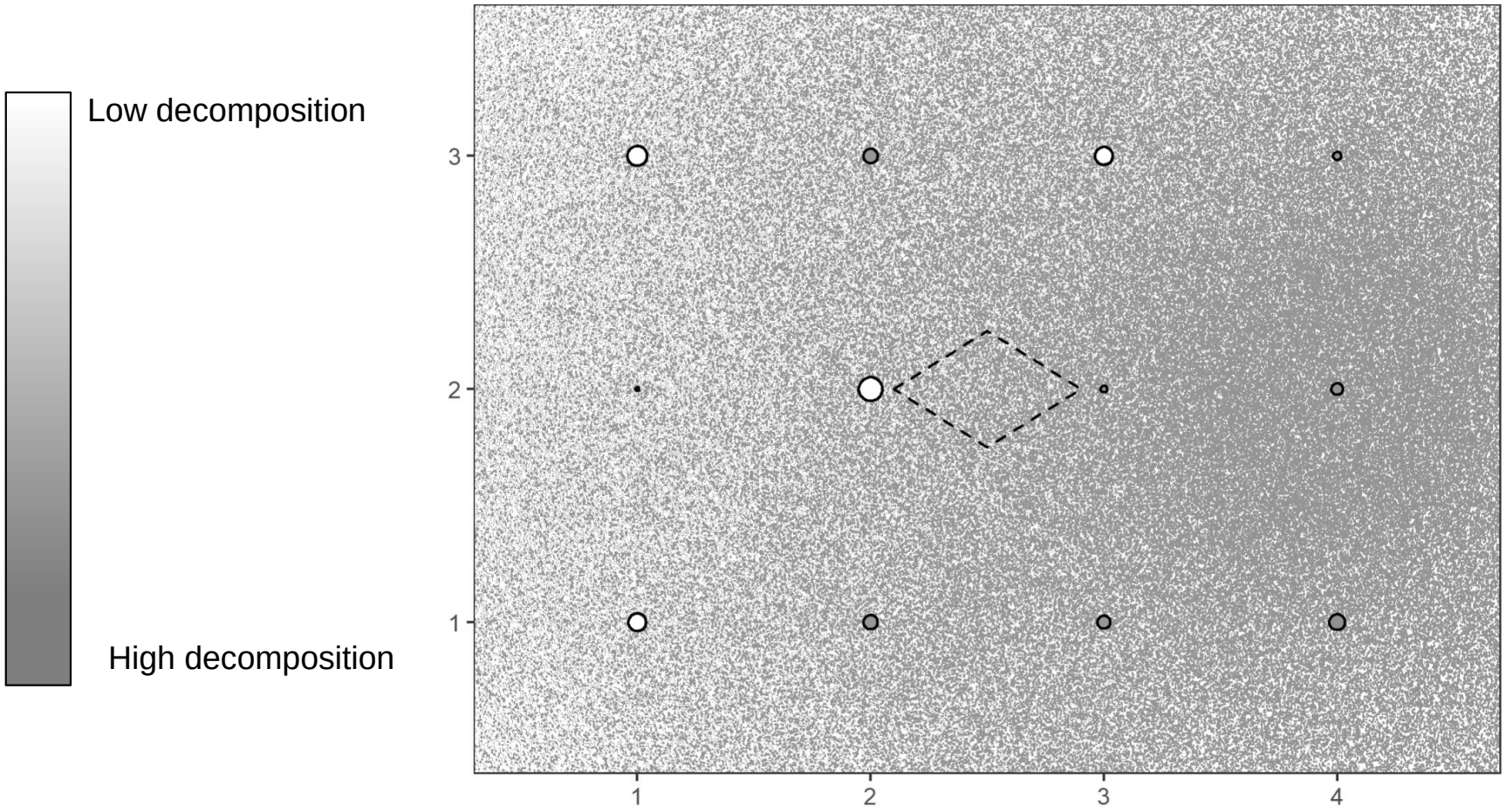
Tree spatial distribution effect

Leaf functional traits effect

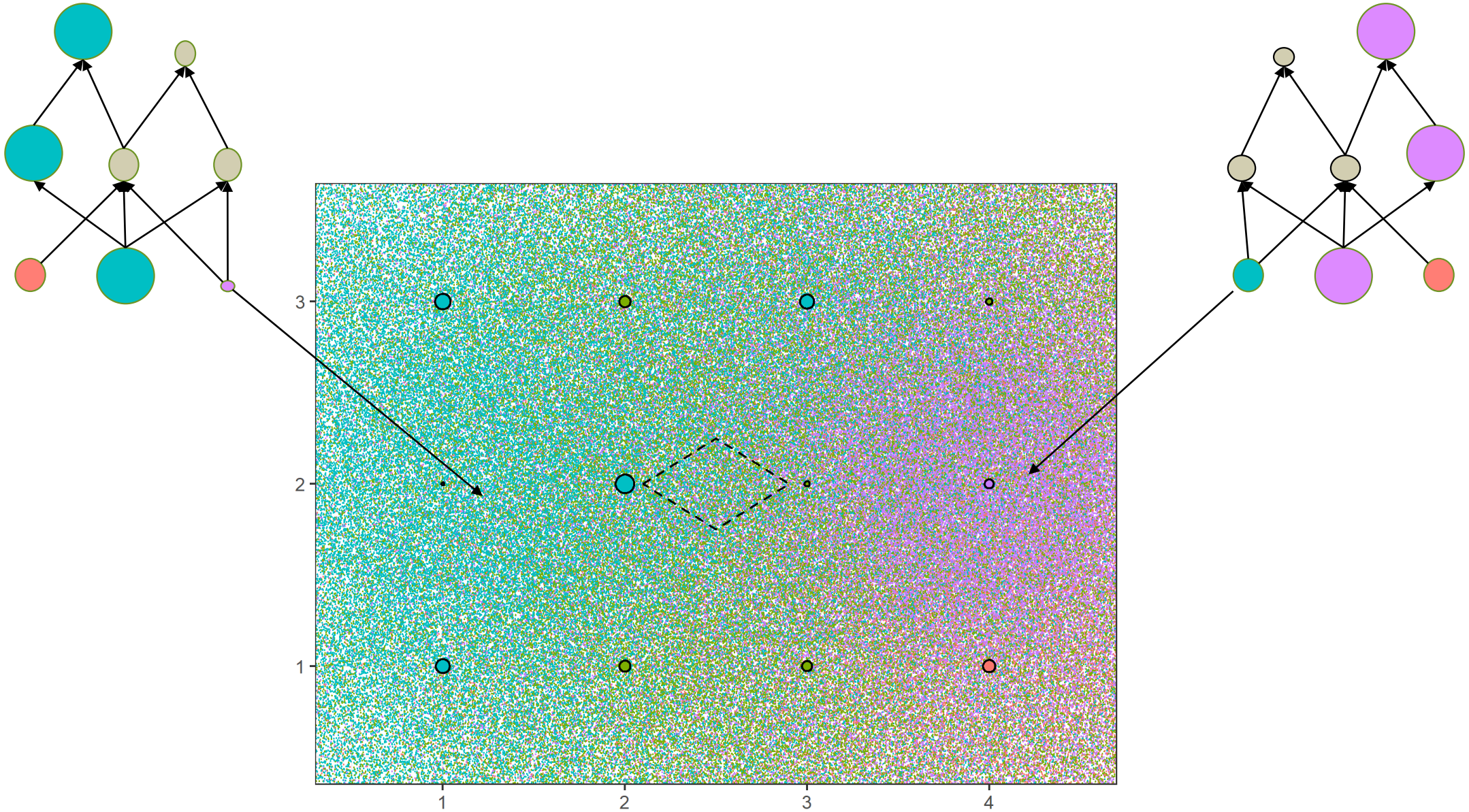
Discussion: spatially distributed litterfall driven by tree biomass and leaf traits



Discussion: spatially heterogenous litter decomposition changes litterfall composition



Discussion: possible mediation by the heterogeneity of microbial decomposer food webs



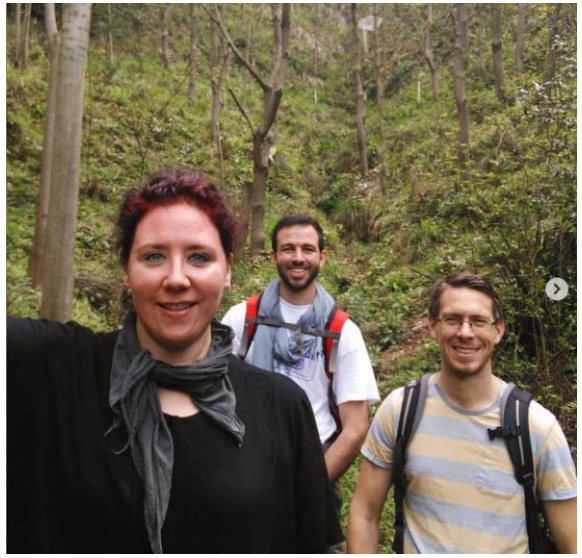
Grman *et al*. 2018; Häussler *et al*. 2020; Mori *et al*. 2018, Mougi and Kondoh 2016; Wang *et al*. 2021

Conclusions

- Tree diversity enhances litter decomposition
  - By increasing the amount and diversity of litterfall
  - By increasing litter decomposability

Conclusions

- Tree diversity enhances litter decomposition
  - By increasing the amount and diversity of litterfall
  - By increasing litter decomposability
- We suggested that tree diversity increases the spatial heterogeneity of tree species
  - With consequences of litterfall distribution
  - and thus litter decomposition



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Field and lab helpers

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Jianqing Du, Sylvia Haider ,

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Bala Singavarapu, Marie Sünnemann,

Lise Thouvenot, Yanfen Wang,

Tesfaye Wubet, Kai Xue

iDiv

TreeDi

experimental interaction ecology

Thank you for your attention

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