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Assessing the role of structurally complex forests as climatic refugia for plant biodiversity

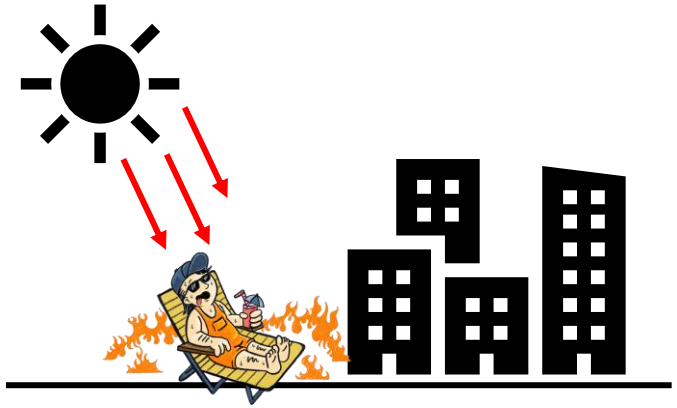
Georg J. A. Hähn

Supervisor: Francesco M. Sabatini
Co-supervisor: Alessandro Chiarucci

Department of Biological, Geological, and Environmental Sciences

BIOME
BIODIVERSITY & MACROECOLOGY
UNIVERSITY OF BOLOGNA

Introduction: Microclimate



Zellweger et al., 2020; Frey et al., 2016; Frenne et al., 2013

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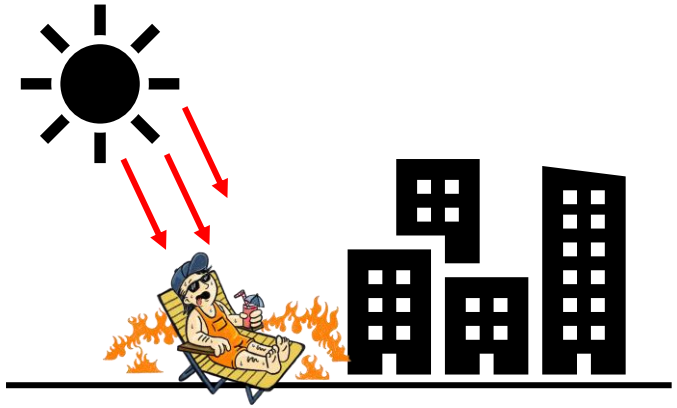

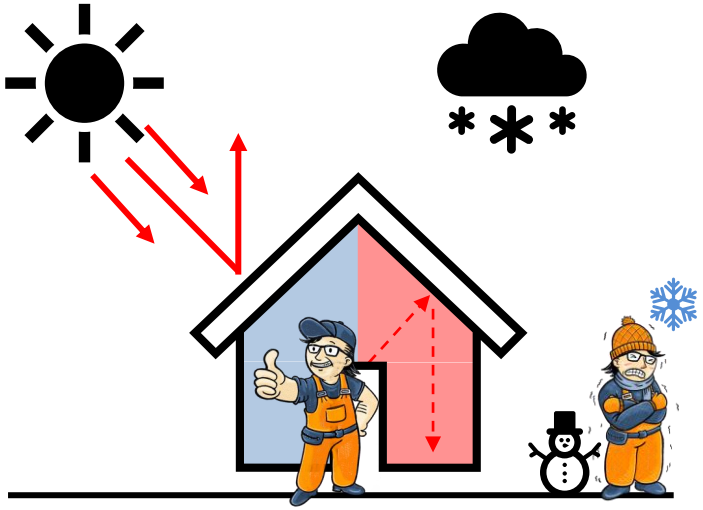

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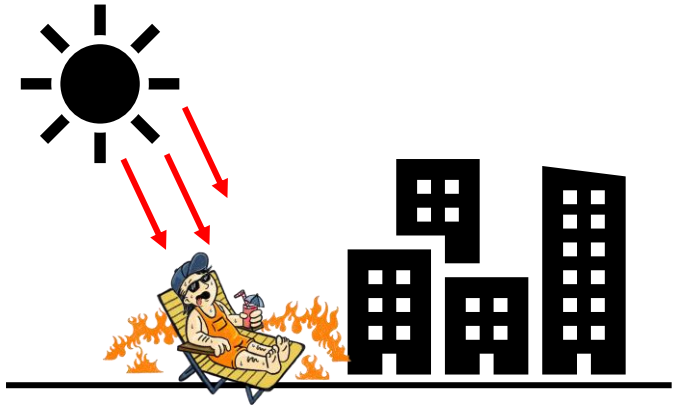

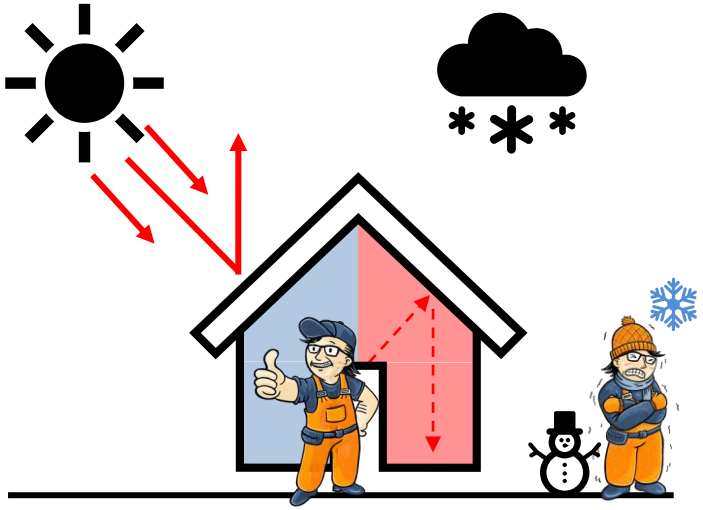

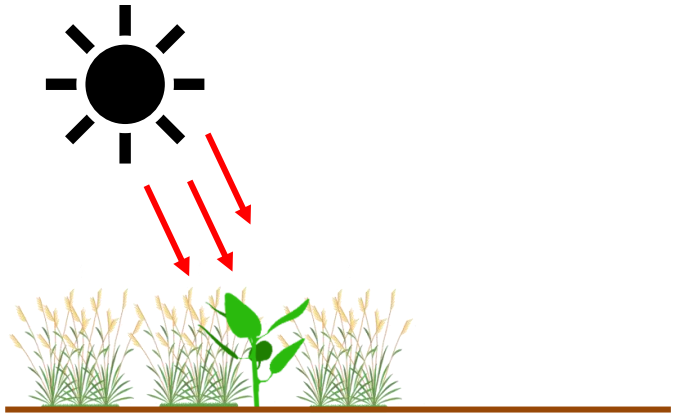

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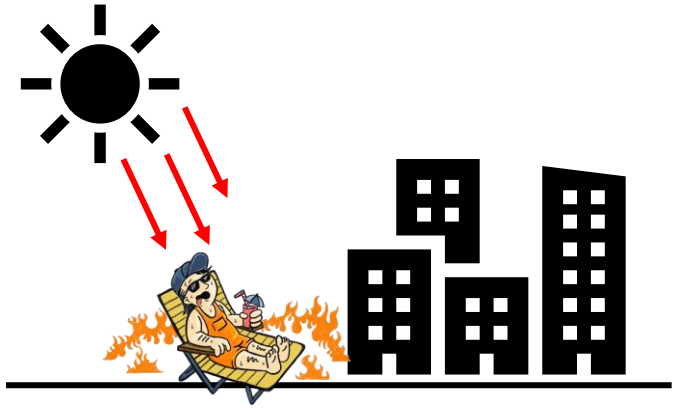

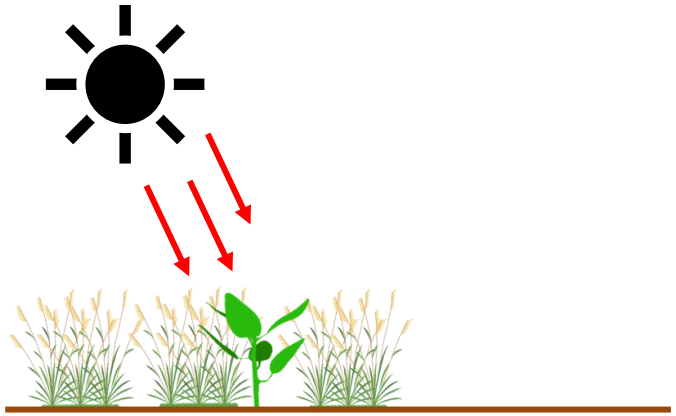

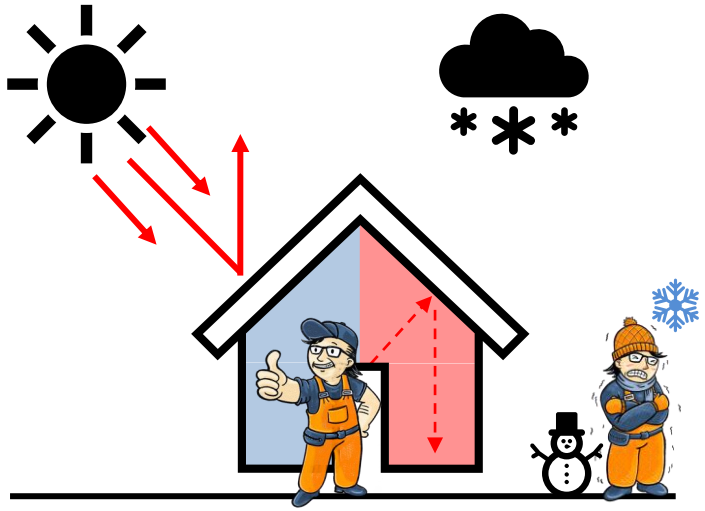

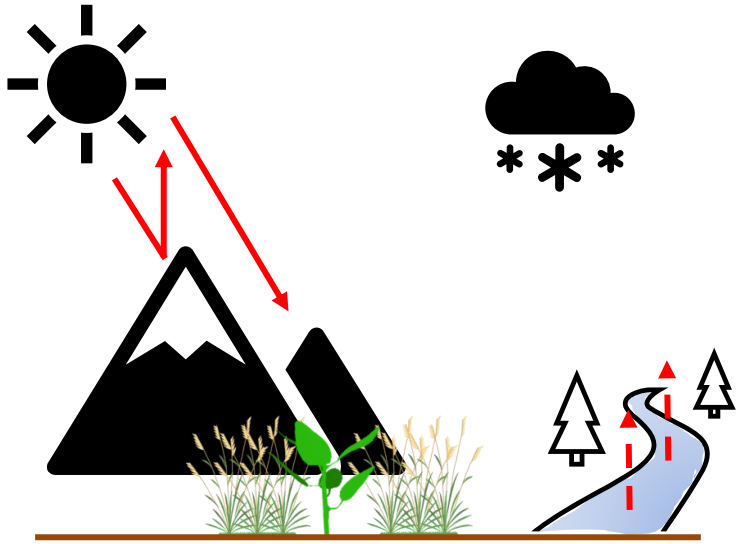

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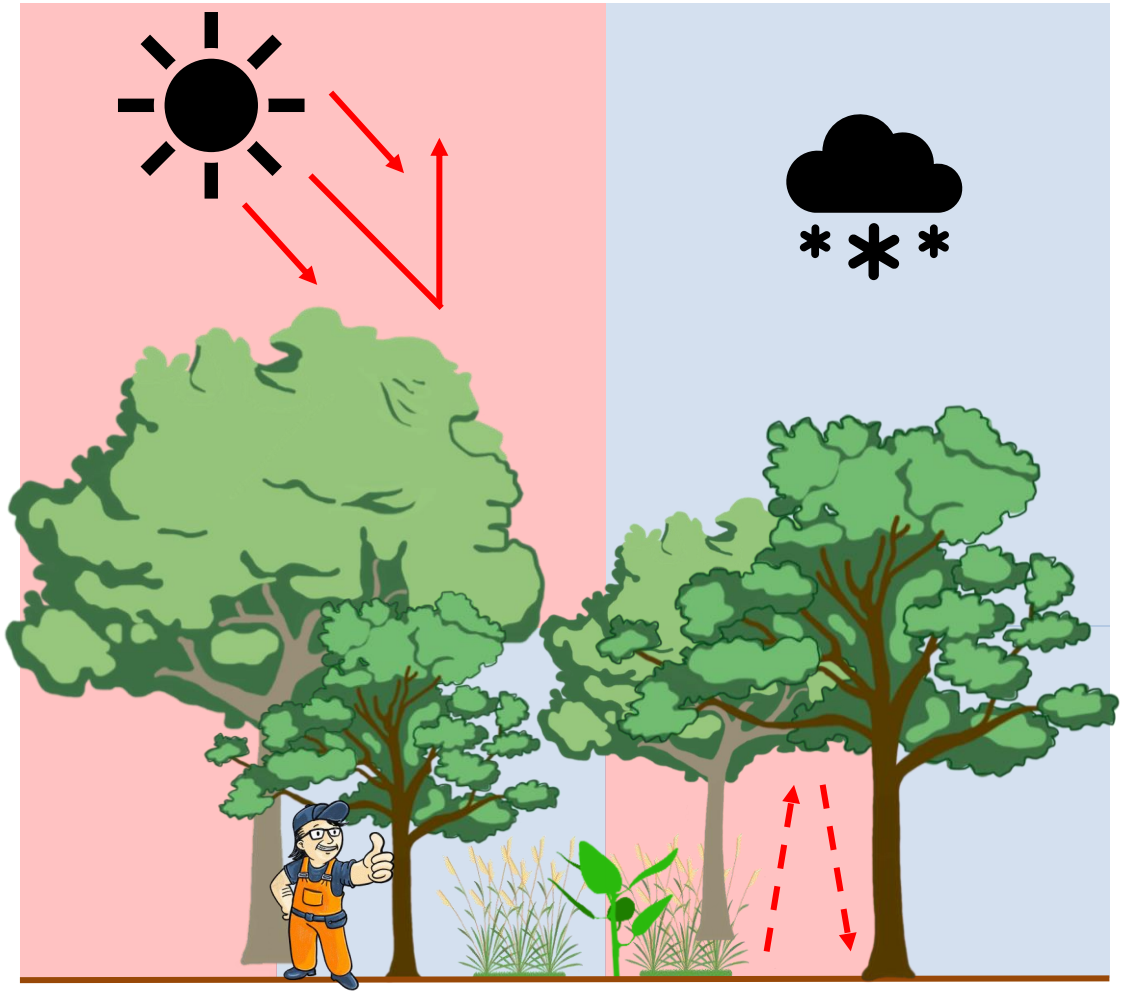

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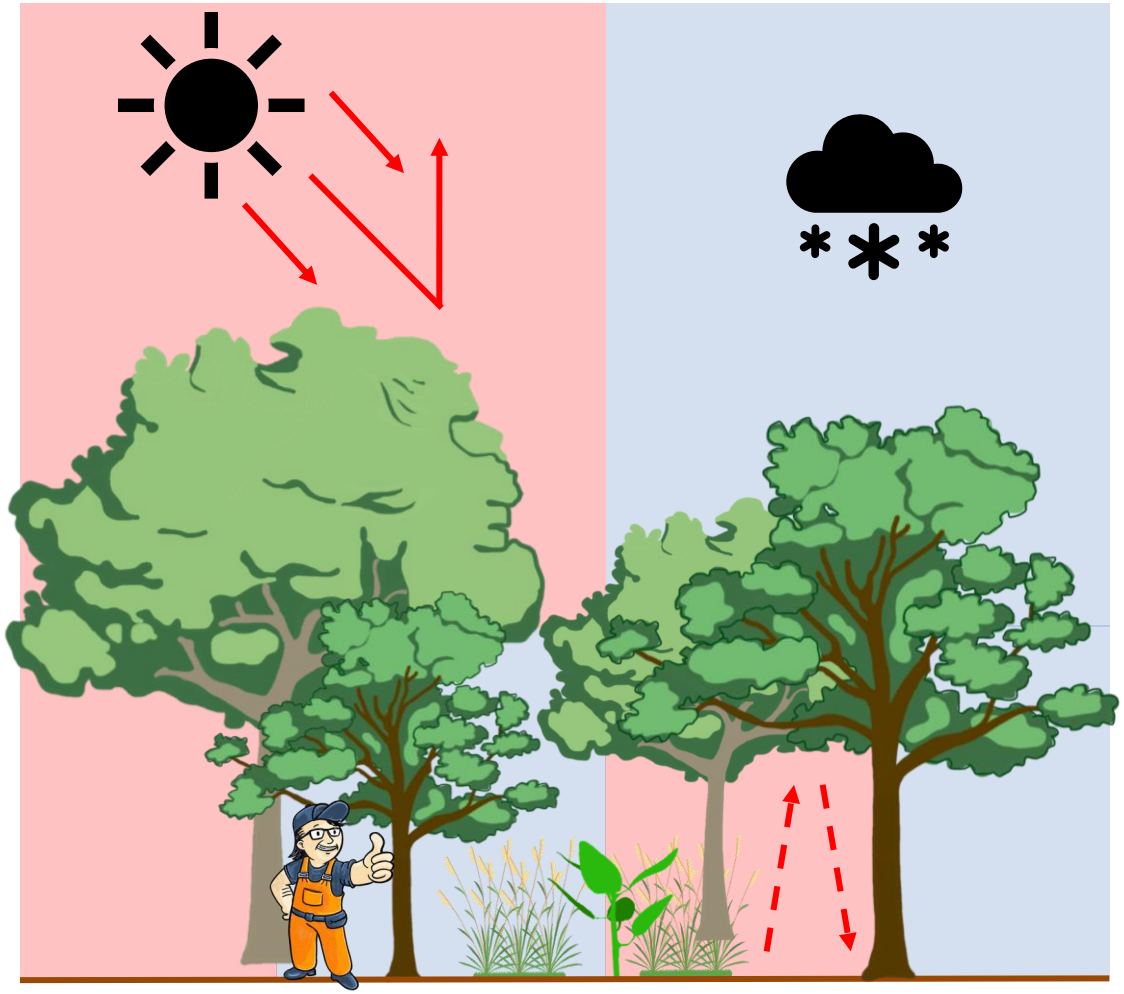
Chapter 1: *Protecting Old-Growth Forests for Biodiversity Conservation amid Climate Change.*

Georg J. A. Hähn, Helge Bruelheide, Alessandro Chiarucci, Michele Di Musciano, Borja Jimenez Alfaro, Tobias Kümmerle & Francesco M. Sabatini (*in preparation*)

Revised publications: >100, between 1995 and 2024



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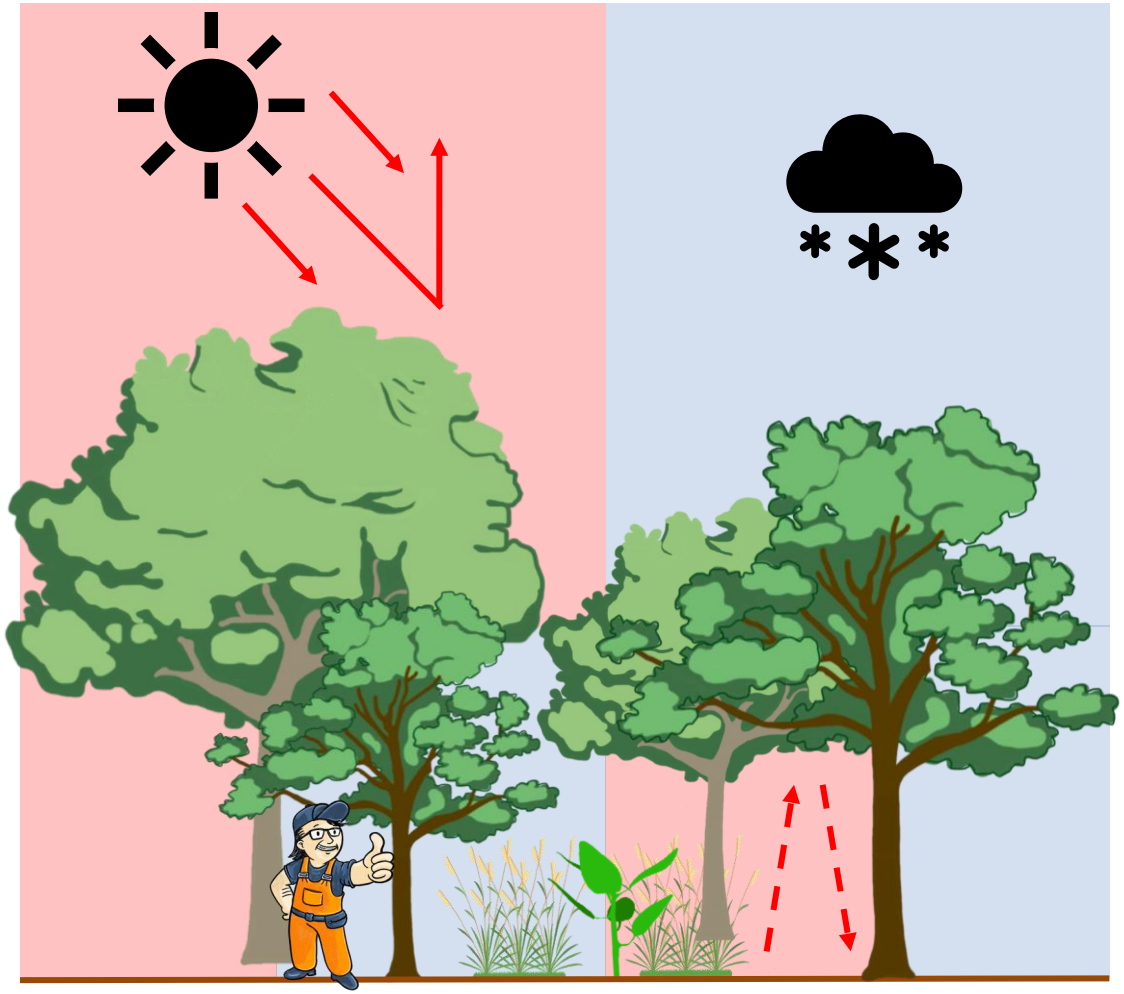

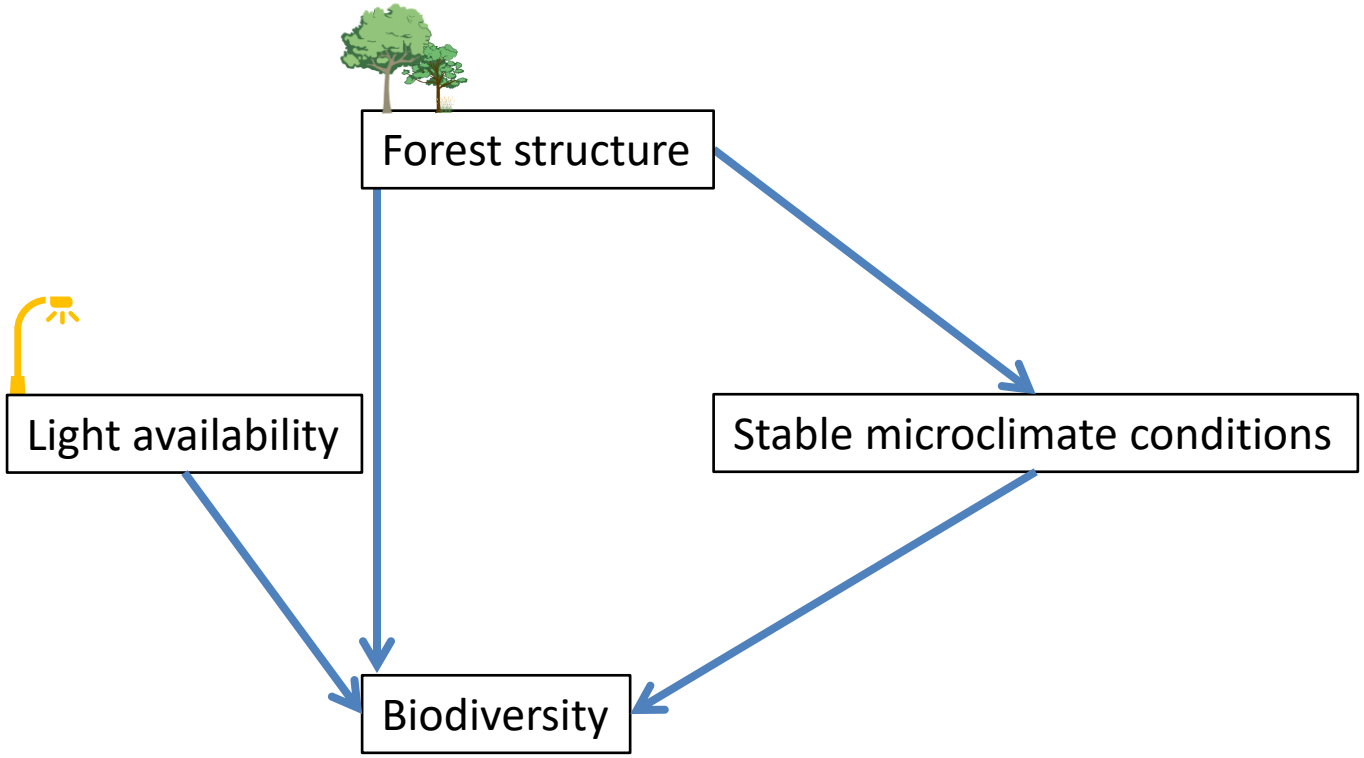

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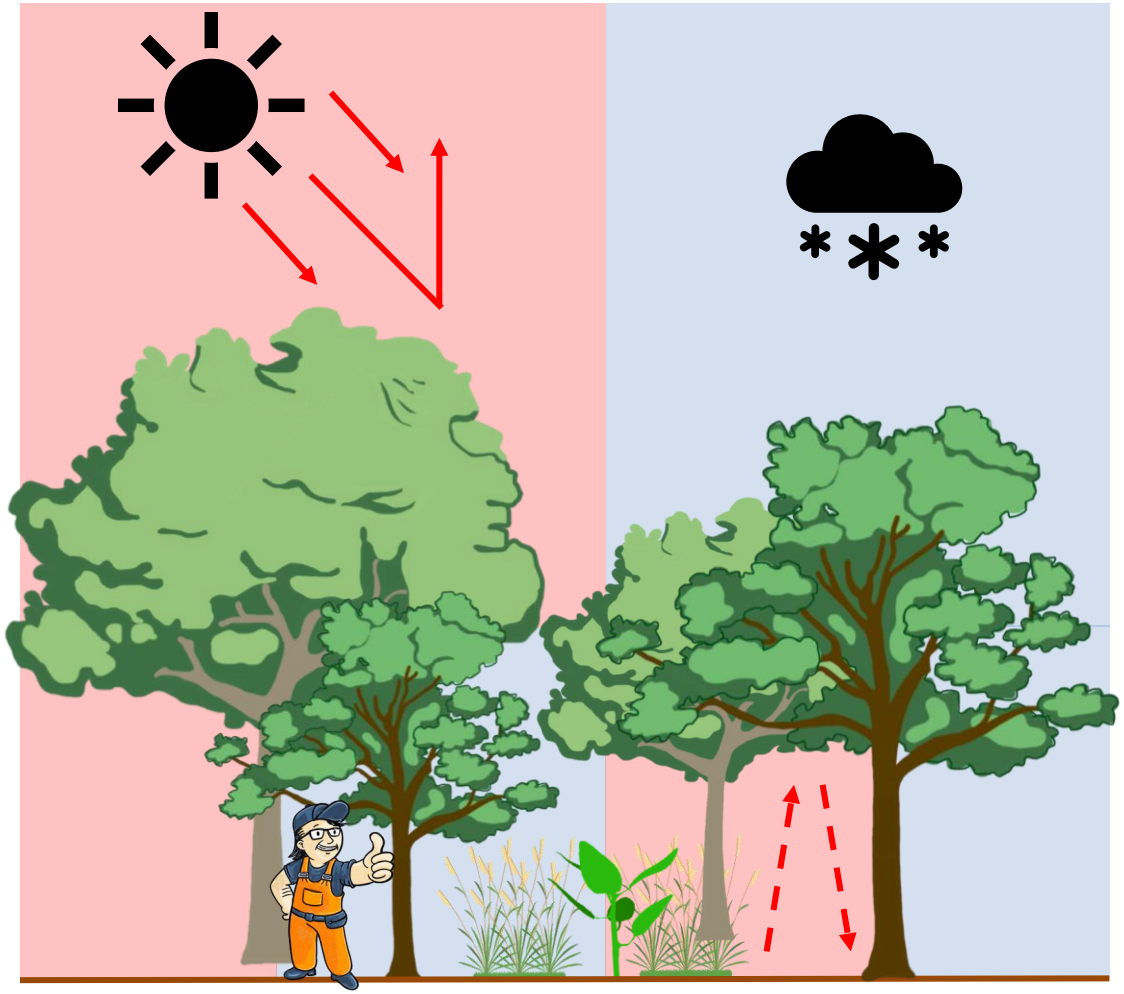

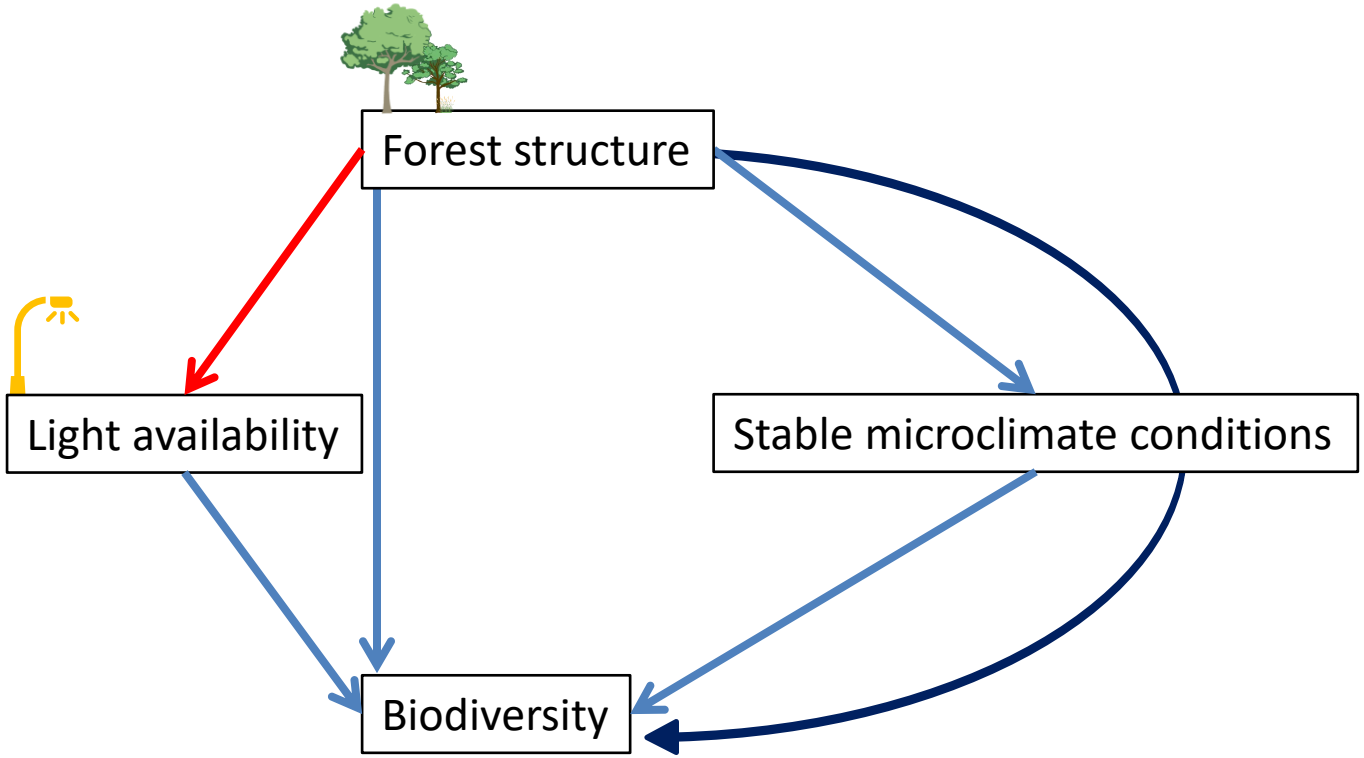

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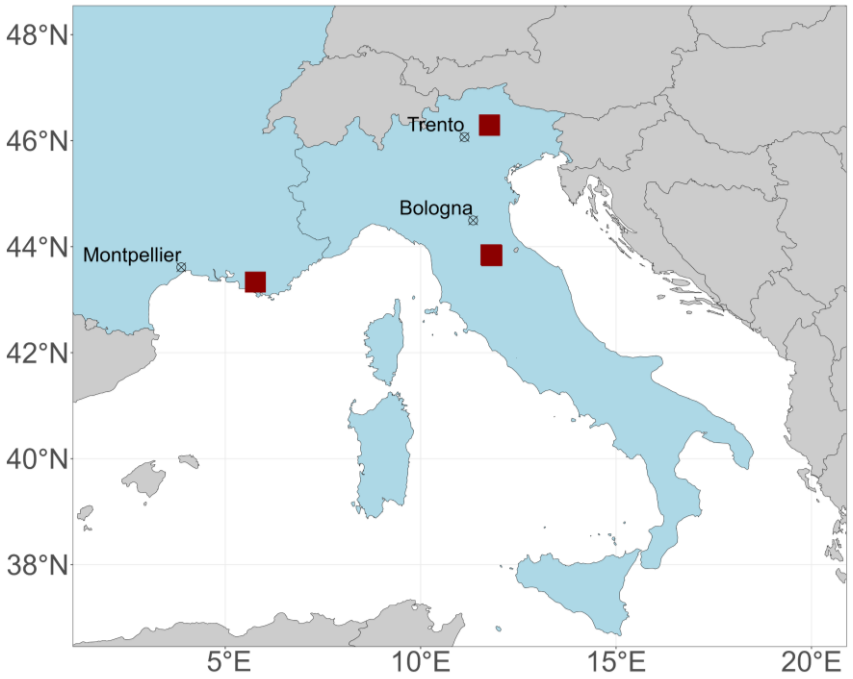
Chapter 2: Methods & Sampling 2024



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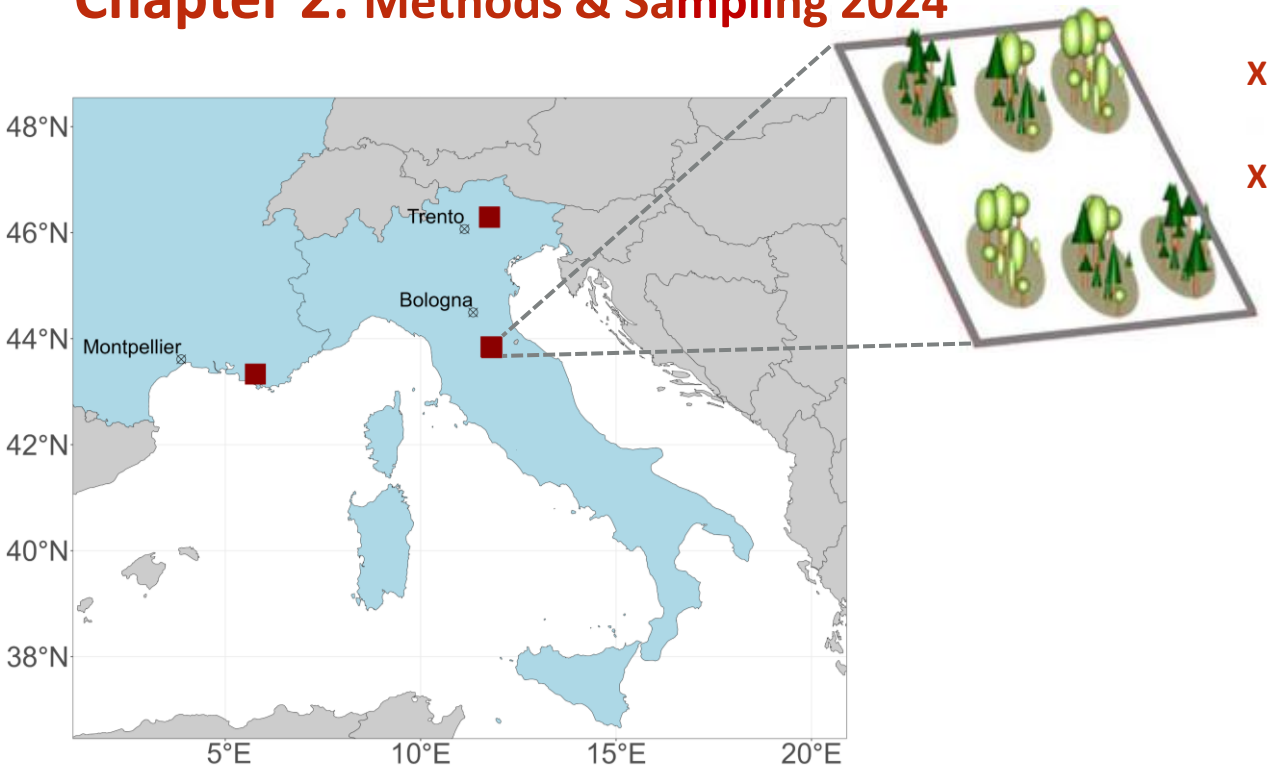

x **4** (Italy)

x **2** (France)

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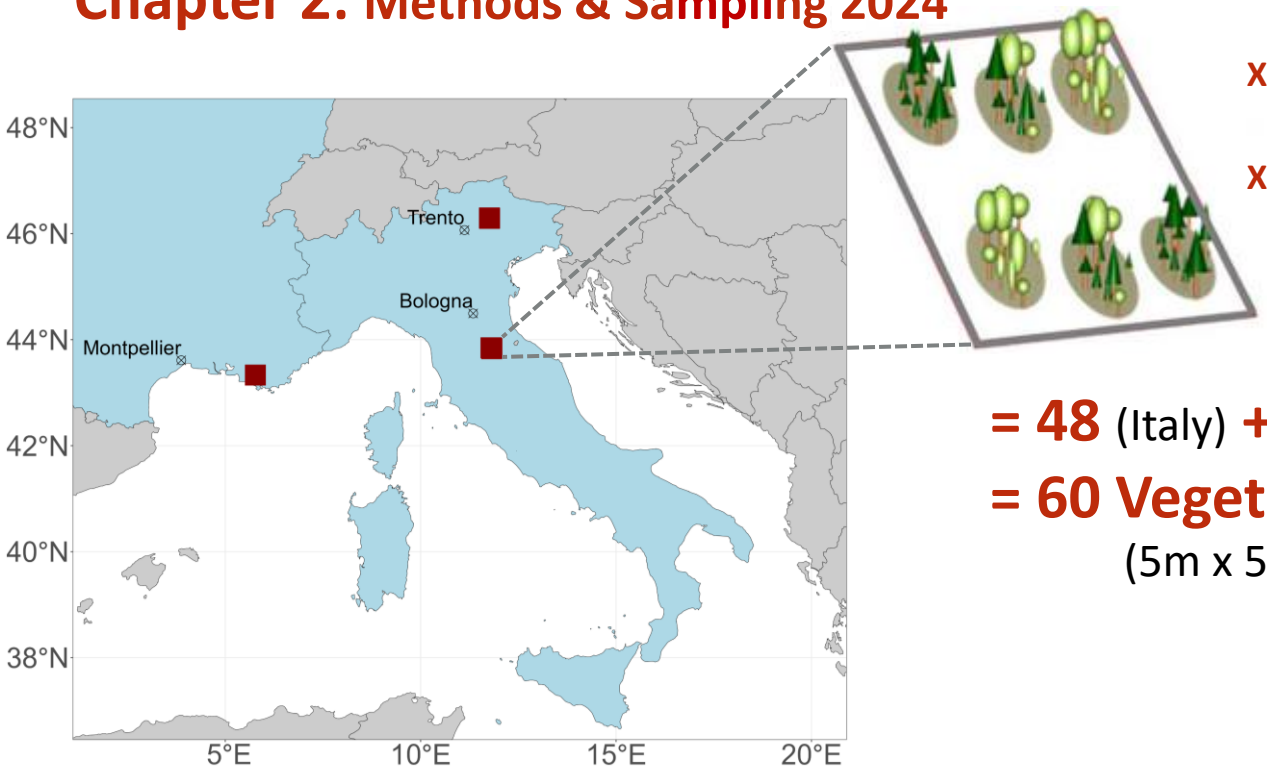

x **4** (Italy)

x **2** (France)

= 48 (Italy) **+ 12** (France)

= 60 Vegetation plots

(5m x 5m)

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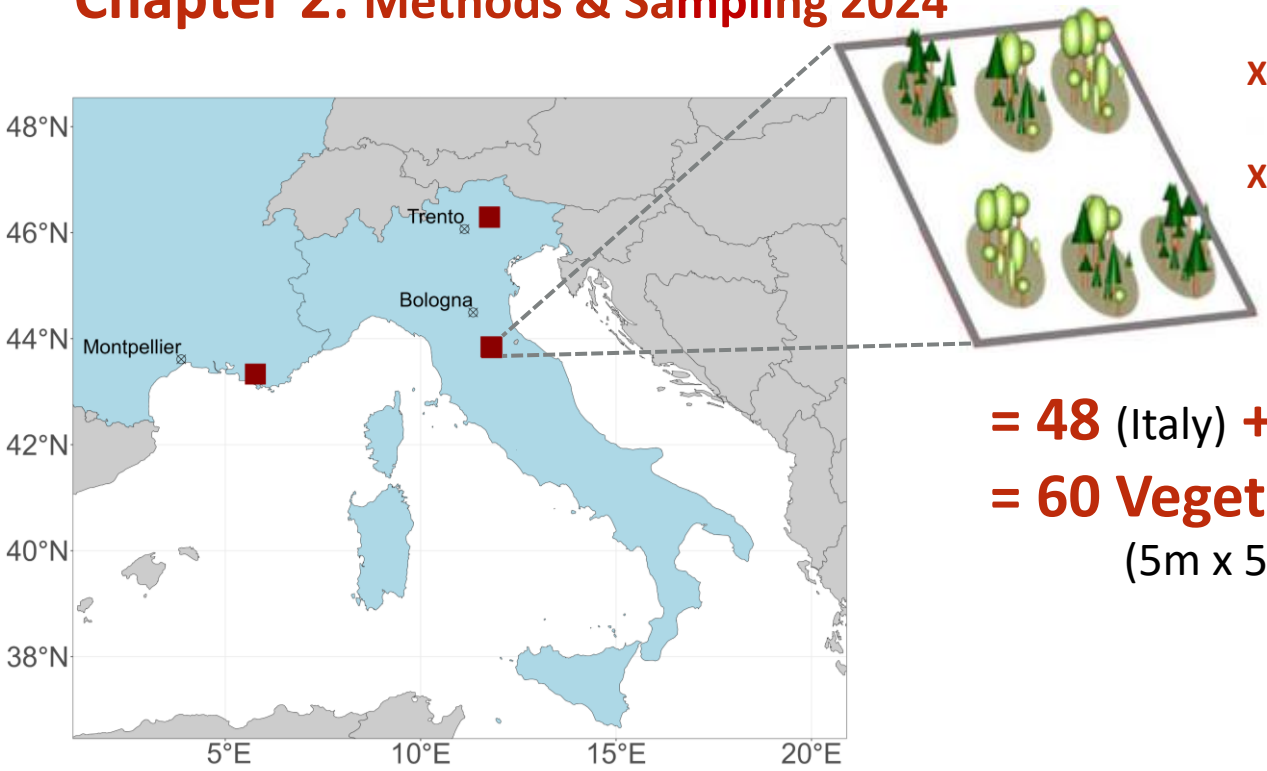

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TMS logger in Sasso Fratino

Explanatory variables:

- Microclimate Temperature/Moisture Sensor (TMS) in the centre
- Terrestrial Laser Scan 1.5m above TMS → Stand Structural Complexity
- Tree diameter → stand biomass
- Hemispherical Densiometer → light availability

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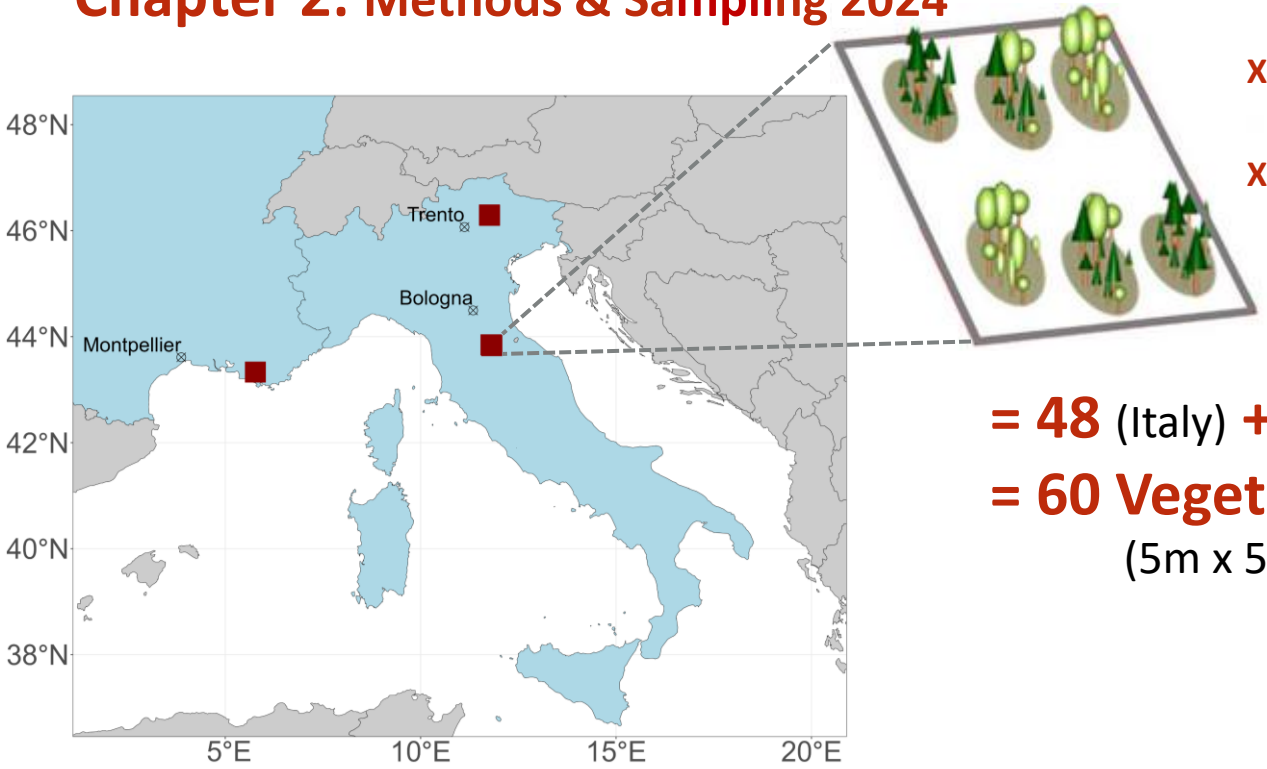

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= 48 (Italy) **+ 12** (France)

= 60 Vegetation plots

(5m x 5m)

TMS logger in Sasso Fratino

Understorey species cover estimation in Paneveggio

Explanatory variables:

- Microclimate Temperature/Moisture Sensor (TMS) in the centre
- Terrestrial Laser Scan 1.5m above TMS → Stand Structural Complexity
- Tree diameter → stand biomass
- Hemispherical Densiometer → light availability

Response variables:

- Understorey vegetation survey, i.e., species richness, species diversity

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Chapter 2: Methods & Sampling 2024

Structural measurements of forests in three (simple)* steps:

Ehbrecht et al., 2017; *optional

Chapter 2: Methods & Sampling 2024

Structural measurements of forests in three (simple)* steps:

Set up a terrestrial laser scanner

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Structural measurements of forests in three (simple)* steps:

Set up a terrestrial laser scanner

Send your colleagues away

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Structural measurements of forests in three (simple)* steps:

Set up a terrestrial laser scanner

Send your colleagues away

Wait 10 minutes and measure some trees in the next plot

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Chapter 2: Methods & Sampling 2024

Structural measurements of forests in three (simple)* steps:

Set up a terrestrial laser scanner

Send your colleagues away

Wait 10 minutes and measure some trees in the next plot

Result of the Terrestrial Laser Scan:

Stand structural complexity (SSCI):

$$SSCI = MeanFrac^{\ln(ENL)}$$

$$= Stand\ density^{\ln(Stand\ vertical\ structure)}$$

Ehbrecht et al., 2017; *optional

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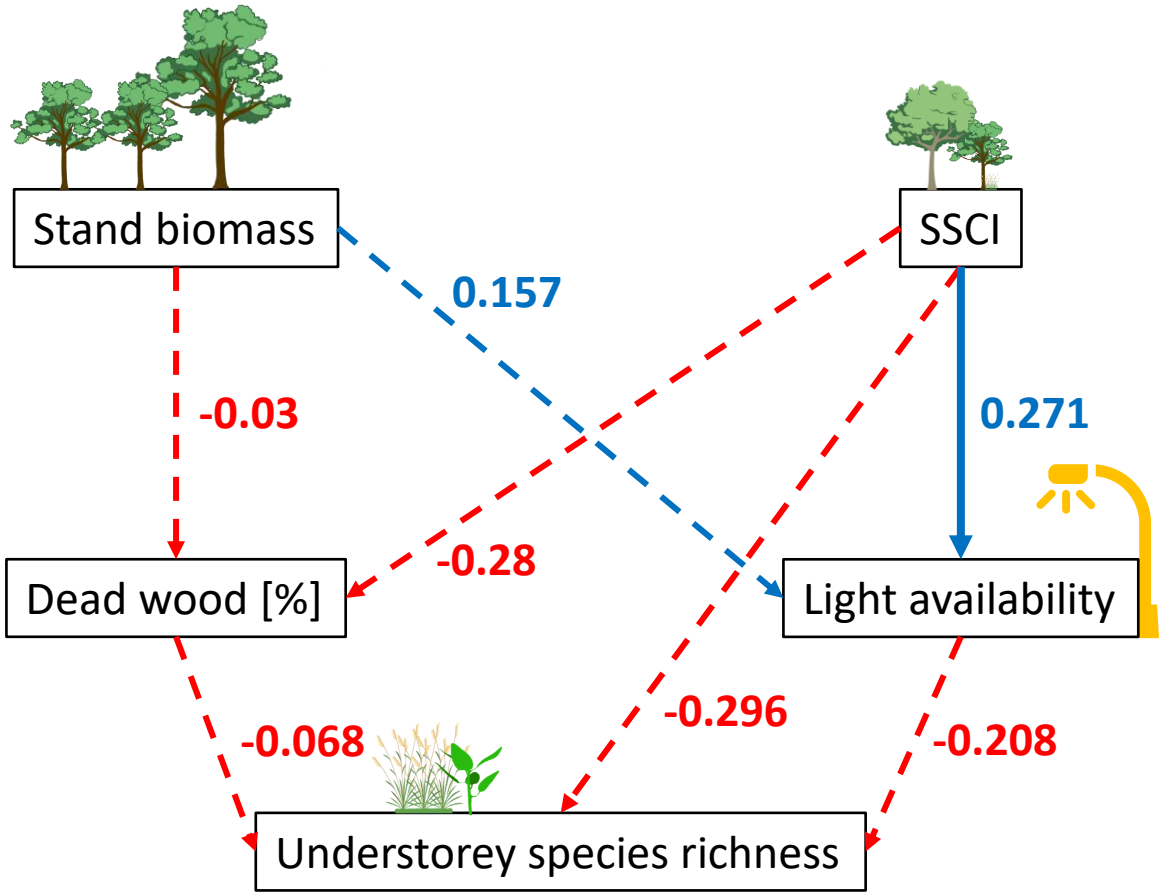
Chapter 2: Preliminary results



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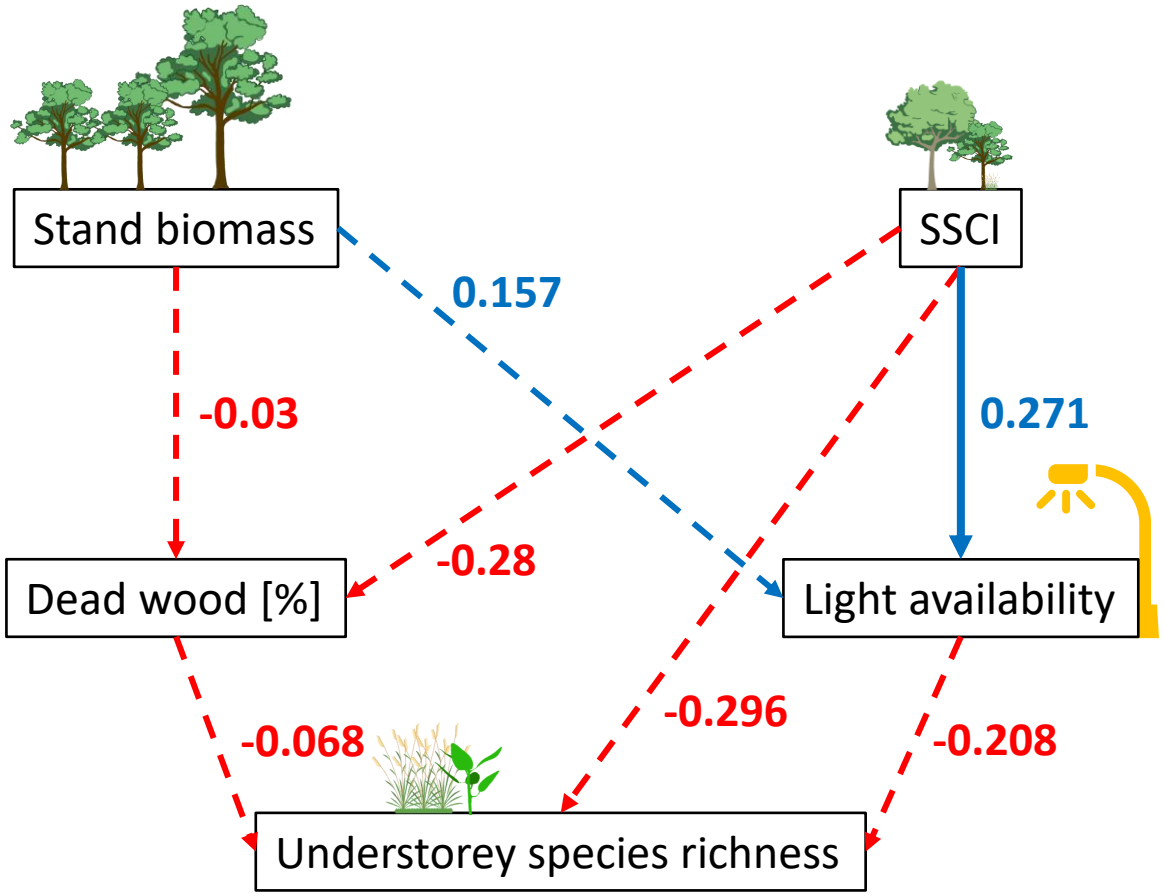

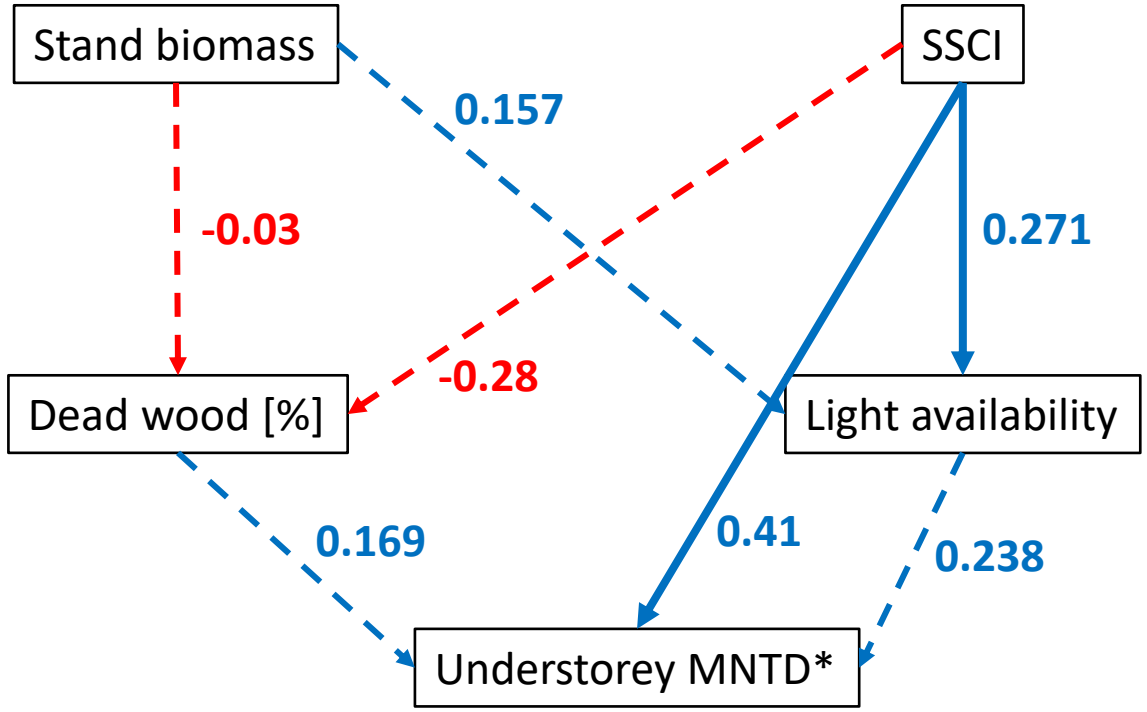

*Mean nearest taxon distance; how close the community is phylogenetically related

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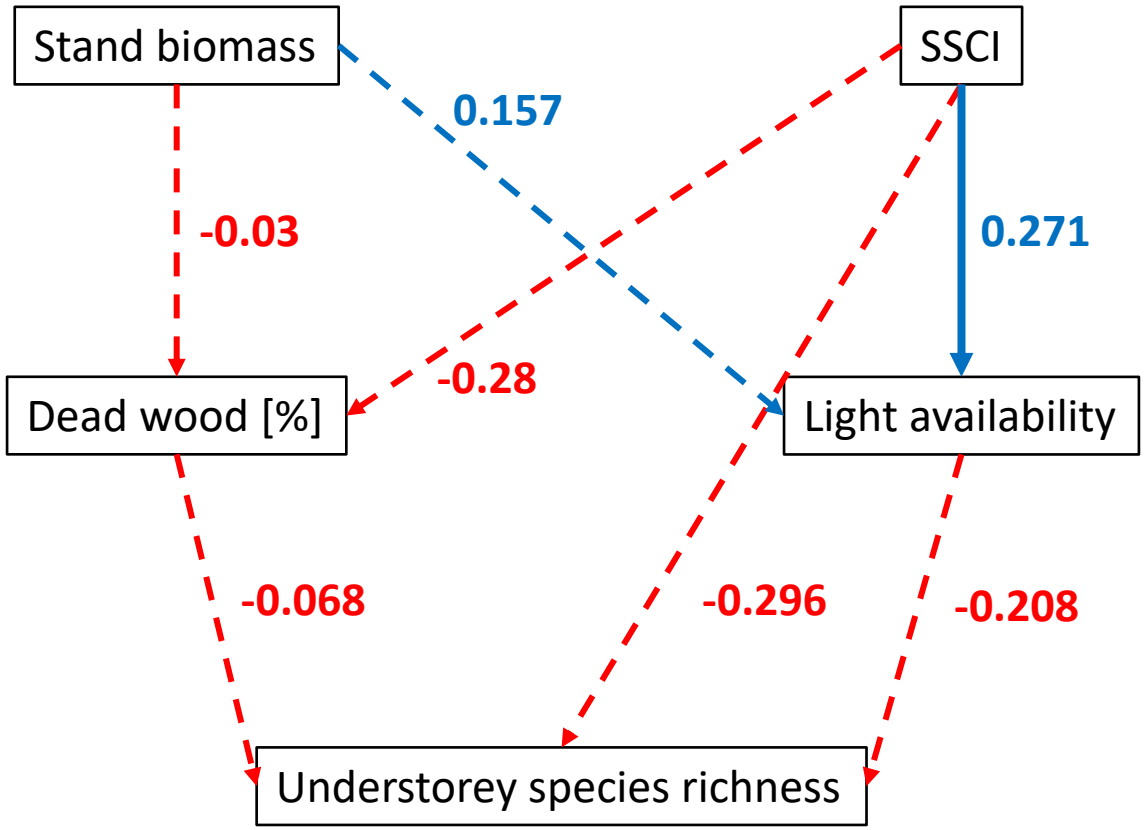
Outlook 2025



1 year of microclimate measurement

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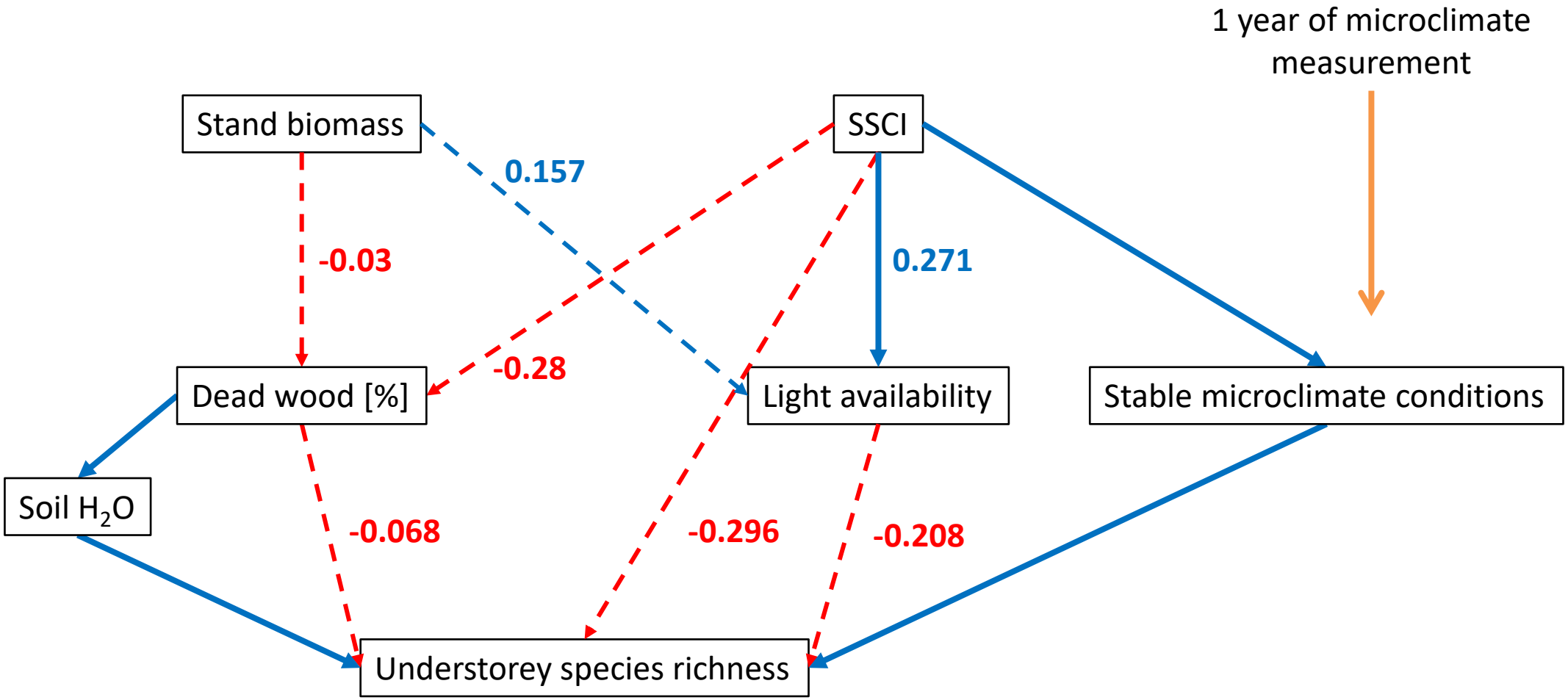

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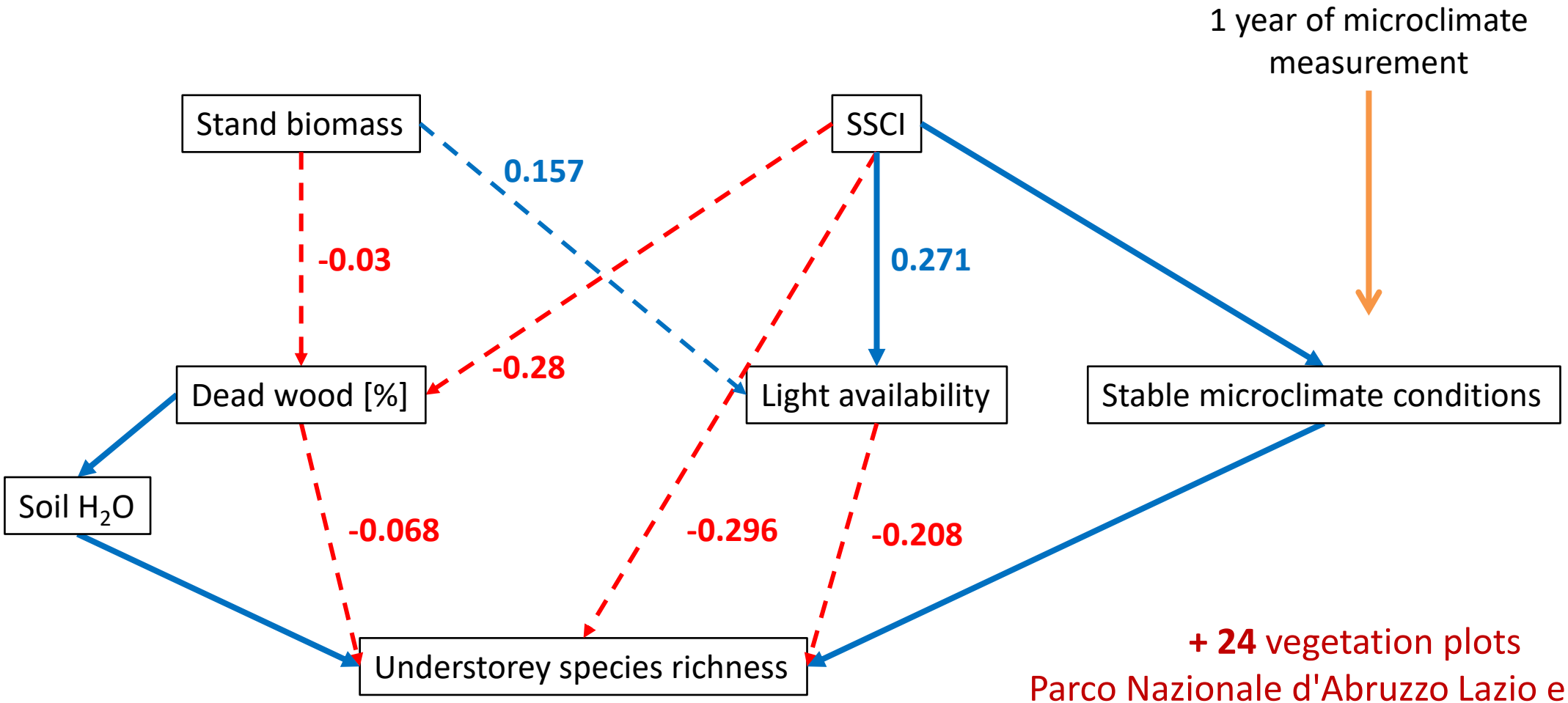

+ 24 vegetation plots
Parco Nazionale d'Abruzzo Lazio e Molise

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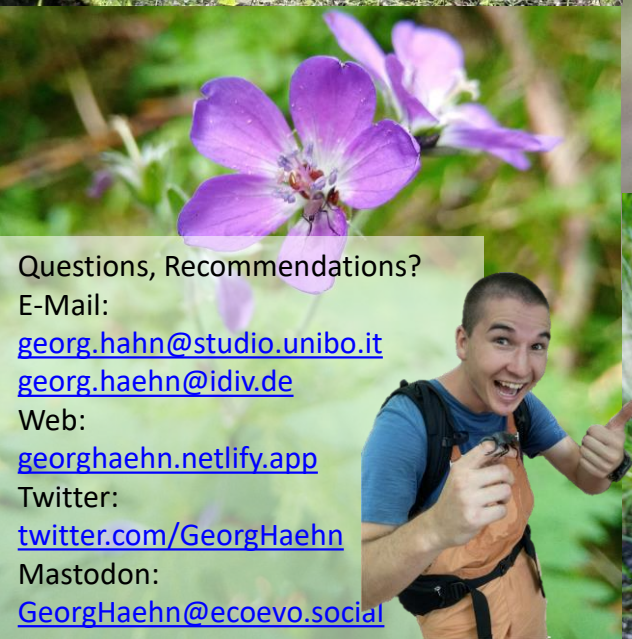
Many thanks to you!

Thanks to:

Francesco M. Sabatini
Alessandro Chiarucci
Riccardo Testolin
Camilla Giacometti
Antonio
Nadia Cappai
Piergiovanni Partel
Casentino Forests National Park
Carabinieri Biodiversity Department of Pratovecchio
Paneveggio-Pale di San Martino Natural Park
Pit Nötzold (Artwork)



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georg.hahn@studio.unibo.it
georg.haehn@idiv.de
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georghaehn.netlify.app
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twitter.com/GeorgHaehn
Mastodon:
GeorgHaehn@ecoevo.social