INTERNATIONAL SCIENTIFIC CONFERENCE

Forest science for people and societal challenges

The 90th "Marin Drăcea" INCDS Anniversary

Impact of active coppice management on microclimate and understorey vegetation in a Mediterranean oak forest

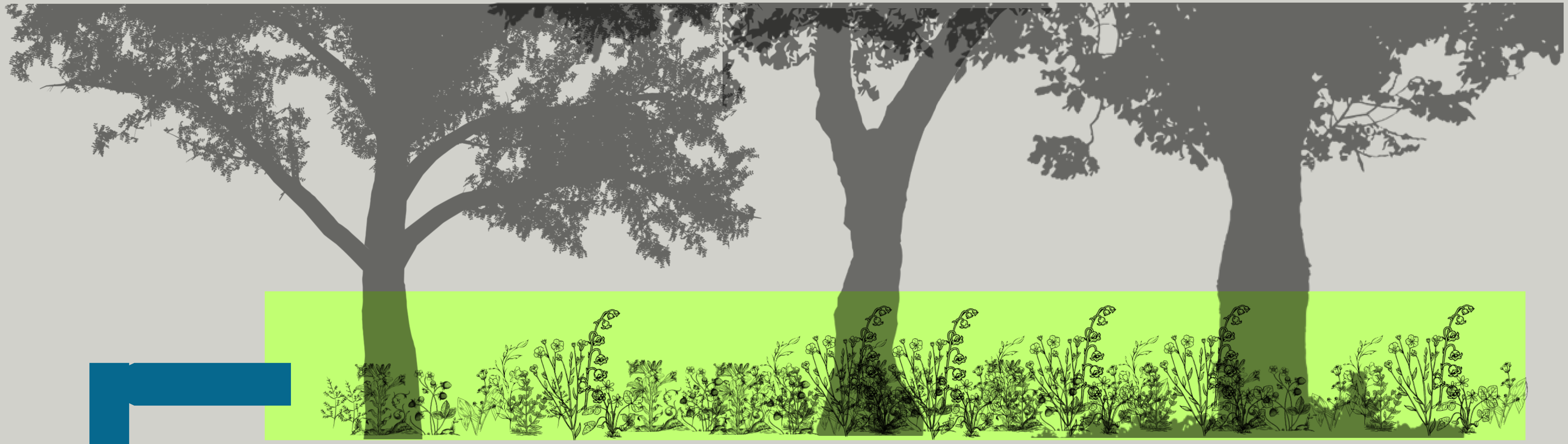
ILARIA SANTI, *ELISA CARRARI, PIETER DE FRENNE, MERCEDES VALERIO GALÁN, CRISTINA GASPERINI, MARCO CABRUCCI, FEDERICO SELVI

UNIVERSITÀ DEGLI STUDI FIRENZE
DAGRI DIPARTIMENTO DI SCIENZE E TECNOLOGIE AGRARIE, ALIMENTARI, AMBIENTALI E FORESTALI

NATIONAL BIODIVERSITY FUTURE CENTER

GHENT UNIVERSITY

1. BACKGROUND



Understorey vegetation (UV) represents the 90% of temperate forest plant diversity (Gilliam 2007)

supports several forest ecosystem services

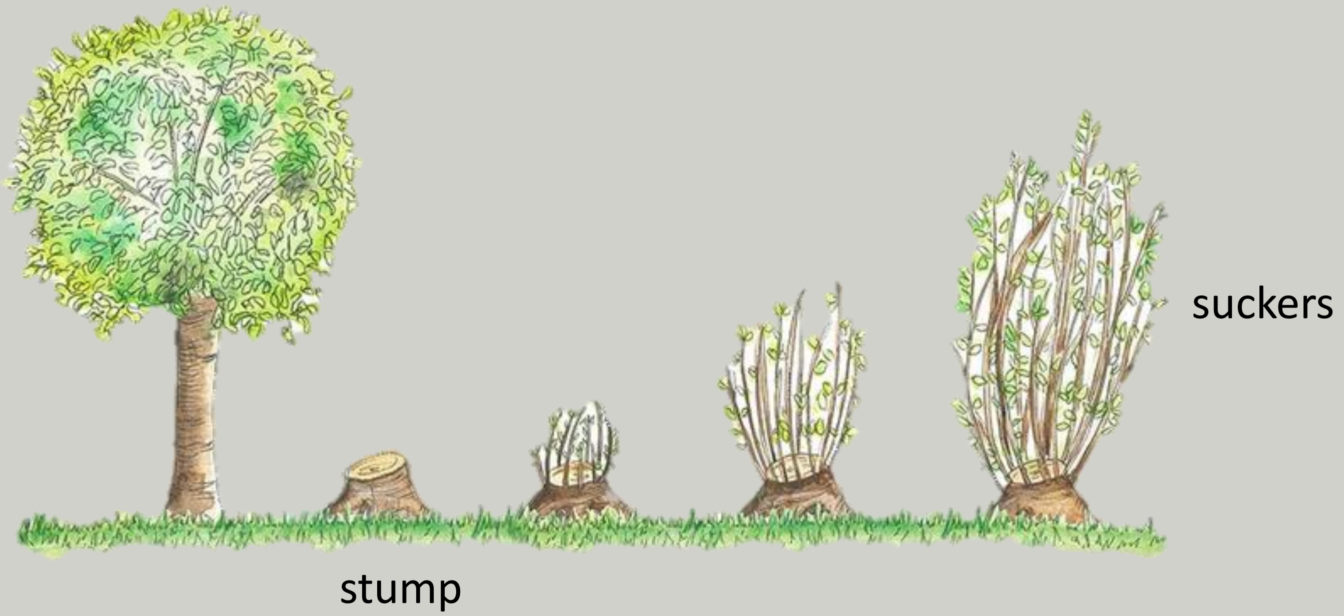
Global warming is causing UV thermophilization!

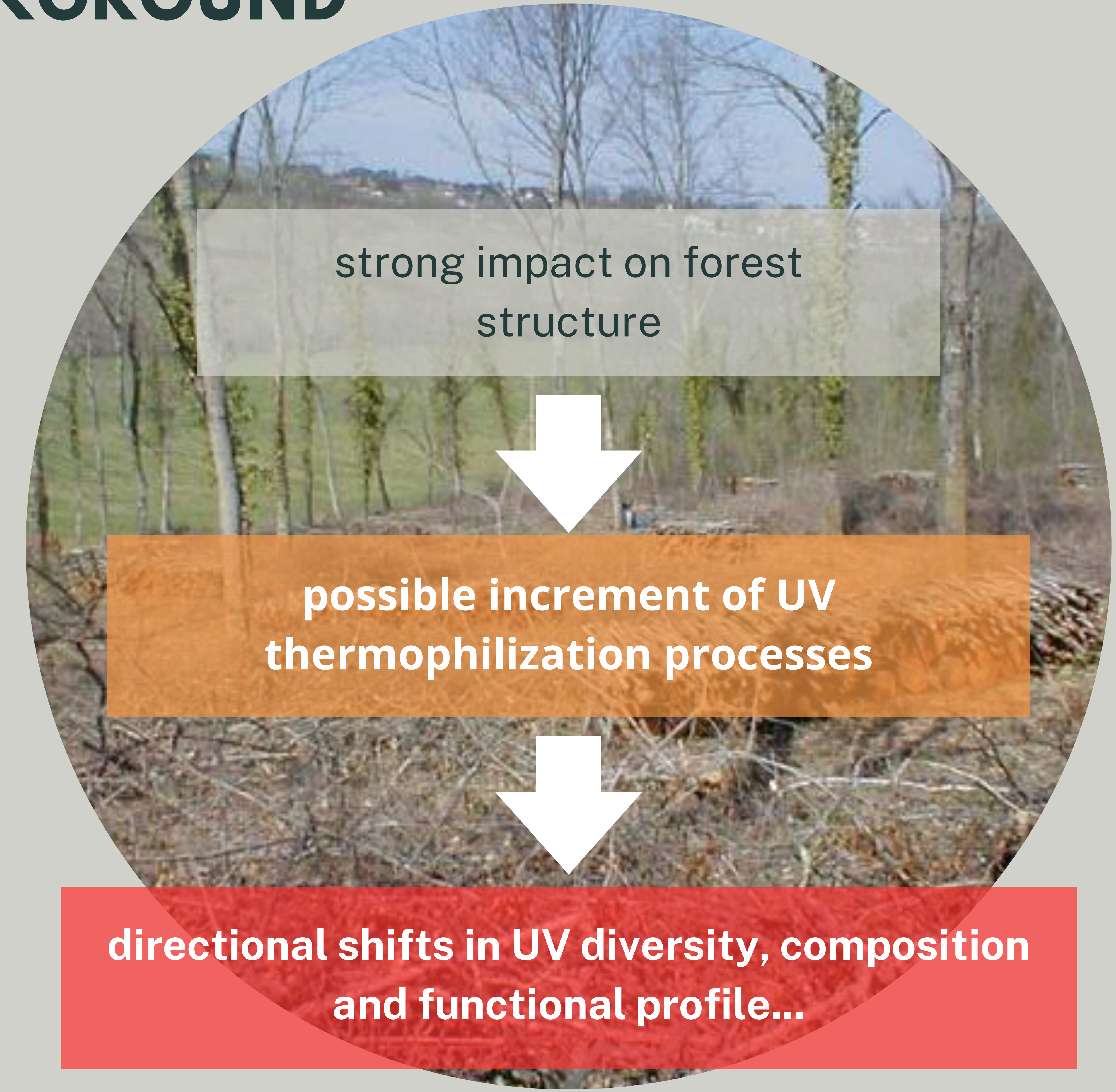
1. BACKGROUND

Forest management is crucial for UV conservation

Coppice management is the traditional management for firewood (oak forests)

Based on cuts at regular time intervals and vegetative regeneration cycles with sproutings





strong impact on forest structure

possible increment of UV thermophilization processes

directional shifts in UV diversity, composition and functional profile...

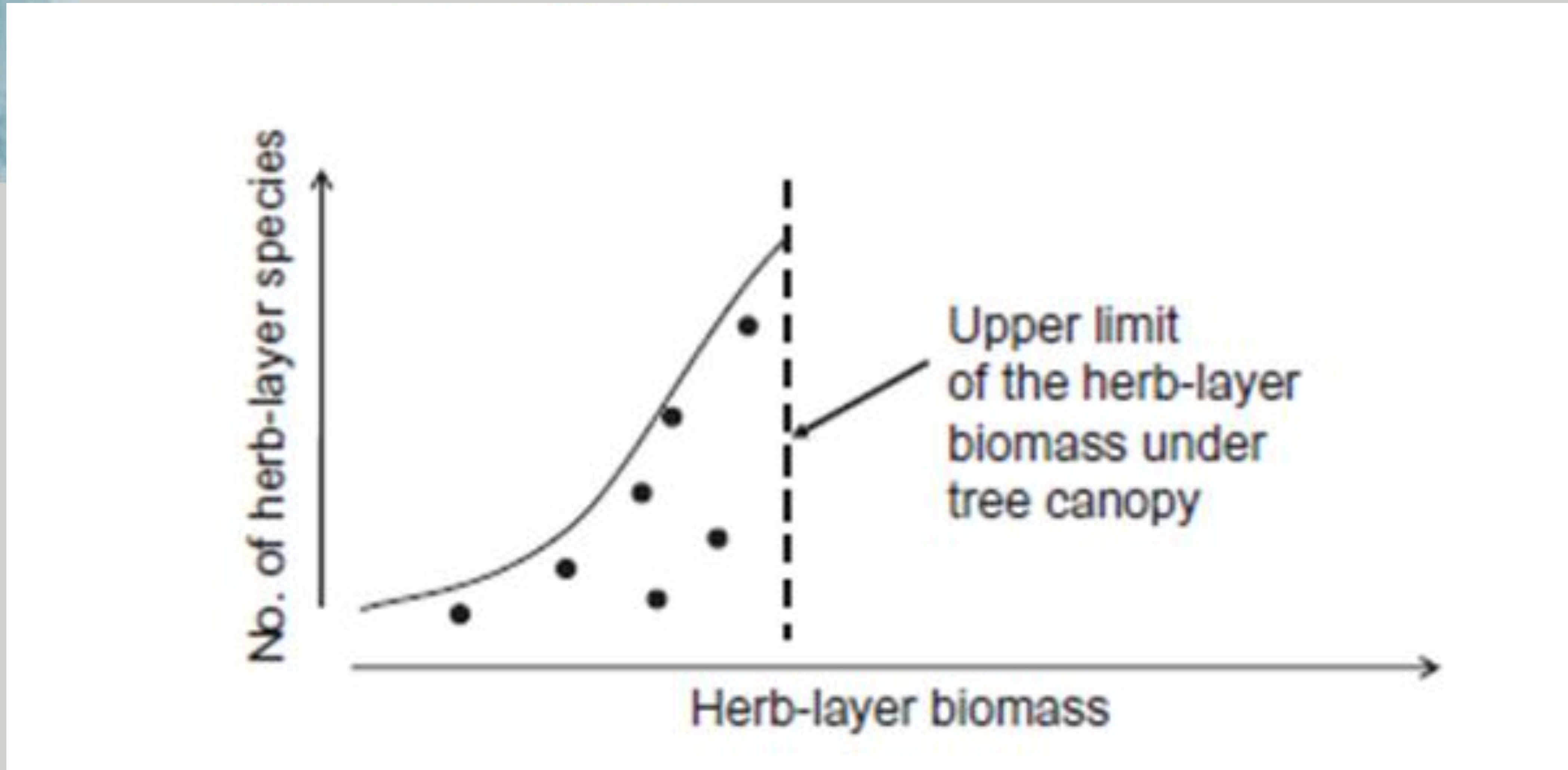
1. BACKGROUND

Global Ecology and Biogeography, (Global Ecol. Biogeogr.) (2012) **21**, 657–667

RESEARCH PAPER

The species richness–productivity relationship in the herb layer of European deciduous forests

Irena Axmanová[1*], Milan Chytrý[1], David Zelený[1], Ching-Feng Li[1], Marie Vymazalová[1], Jiří Danihelka[1,2], Michal Horsák[1], Martin Kočí[1], Svatava Kubešová[1,3], Zdeňka Lososová[1,4], Zdenka Otýpková[1], Lubomír Tichý[1], Vasiliy B. Martynenko[5], El'vira Z. Baisheva[5], Brigitte Schuster[6] and Martin Diekmann[6]



THE ALTERED FOREST STRUCTURE CAUSED BY COPPICE INCREASES LIGHT AVAILABILITY

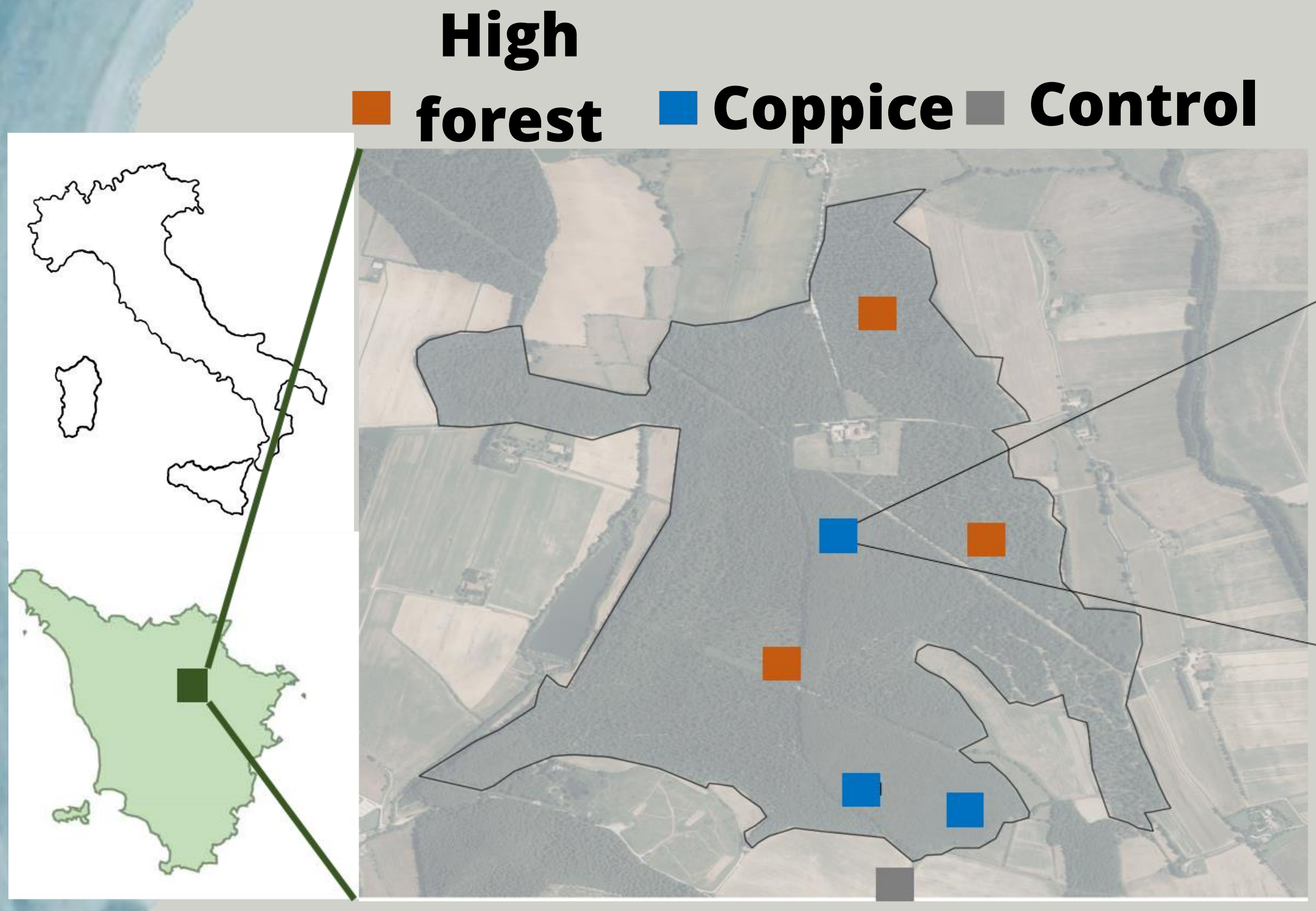
THIS MAY AFFECT THE EXPECTED RELATIONSHIP BETWEEN SR AND PRODUCTIVITY

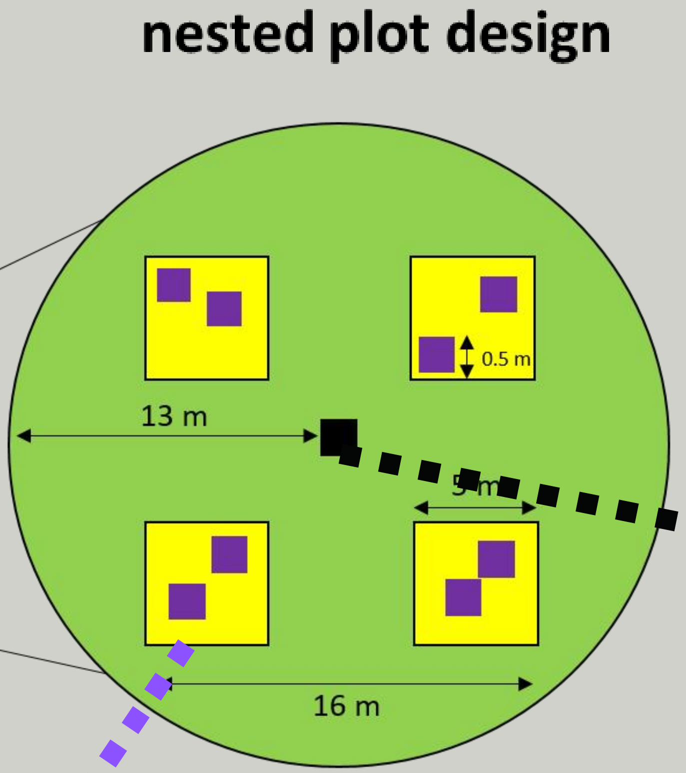
2. STUDY QUESTIONS

- HOW IS FOREST TEMPERATURE BUFFERING CAPACITY IMPACTED BY COPPICING ?

- WHAT ARE THE EFFECTS ON UV DIVERSITY (TAXONOMIC, FUNCTIONAL, PHYLOGENETIC) AND PRODUCTIVITY?

3. SAMPLING DESIGN





Deciduous mixed oak forest of central Tuscany (Italy)

- **AIR AND SOIL TEMPERATURE (2021-2022)**
- **STRUCTURAL VARIABLES, OVERSTOREY COMPOSITION, PAR, pH**
- **UNDERSTOREY SURVEY**
- **BIOMASS COLLECTION**

3. METHODS DIVERSITY ASSESSMENT AT DIFFERENT LEVELS

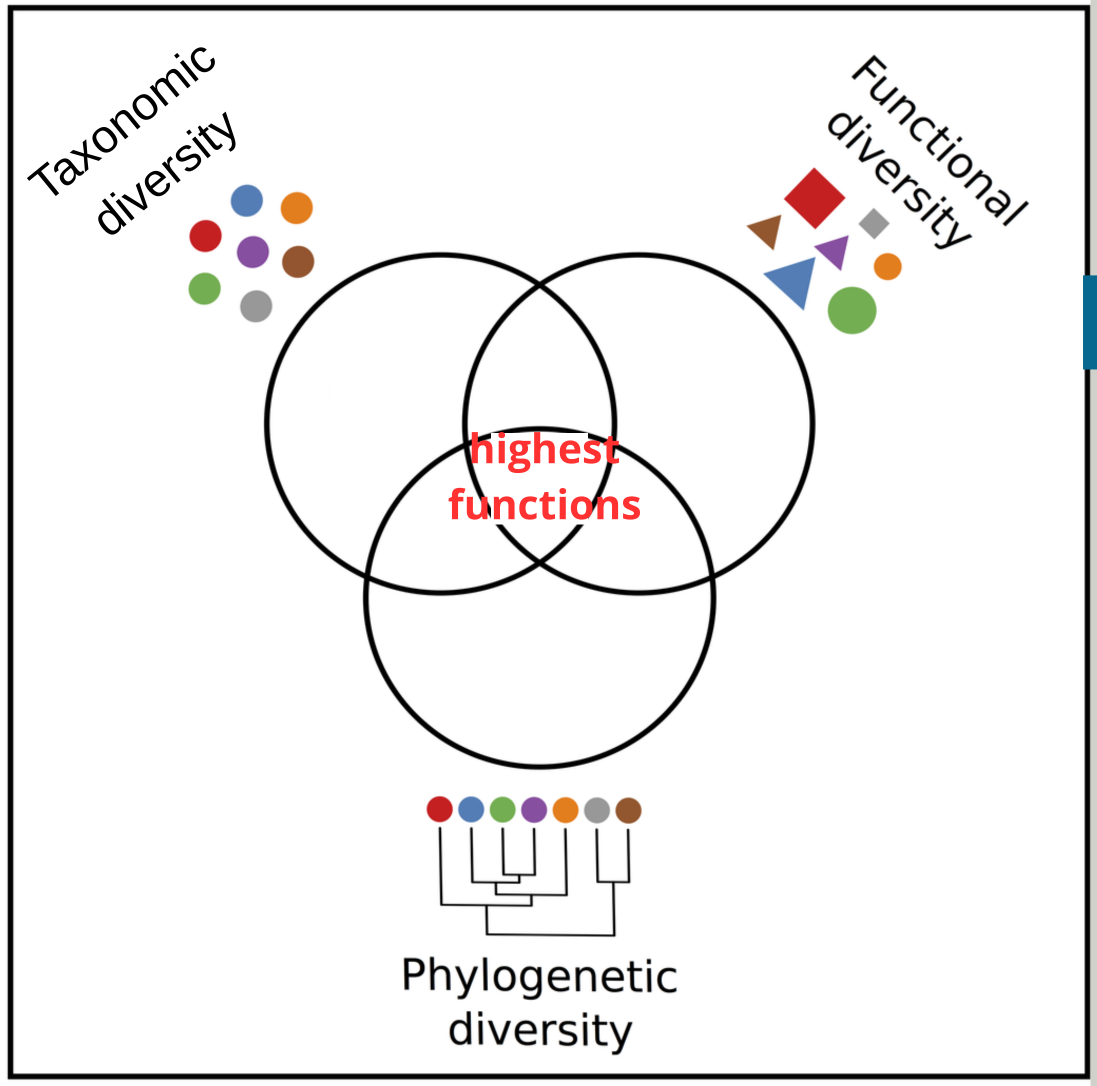
THOMPSON ET AL.2015

SPECIES RICHNESS (SR),
SHANNON INDEX (H'),
EVENNESS (J)

COMPOSITION

Indicator species,
forest guilds (Heinken classification)

R packages: vegan, Indicspecies



SPECIFIC LEAF AREA INDEX (SLA)
LEAF DRY MATTER CONTENT (LDMC)
VEGETATIVE HEIGHT (VEGH),
REPRODUCTIVE HEIGHT (REPH)

collected from TRY DB

community weighted value: CWM
value standardized on SR: RAO.ses

R package: FD

PHYLOGENETIC DIVERSITY (PD),
MEAN NEAREST TAXON DISTANCE (MNTD), MEAN PAIRWAISE DISTANCE (MPD)

value standardized on SR: PD.ses, Mntd.ses, mpd.ses

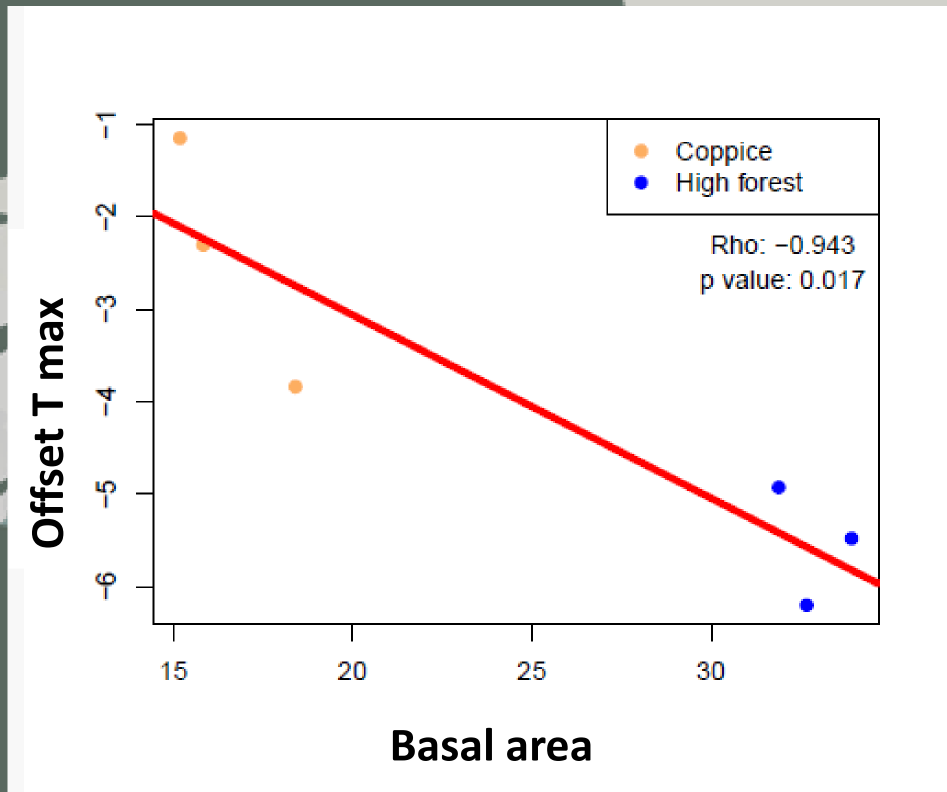
R packages: V.PhyloMaker2, Picante

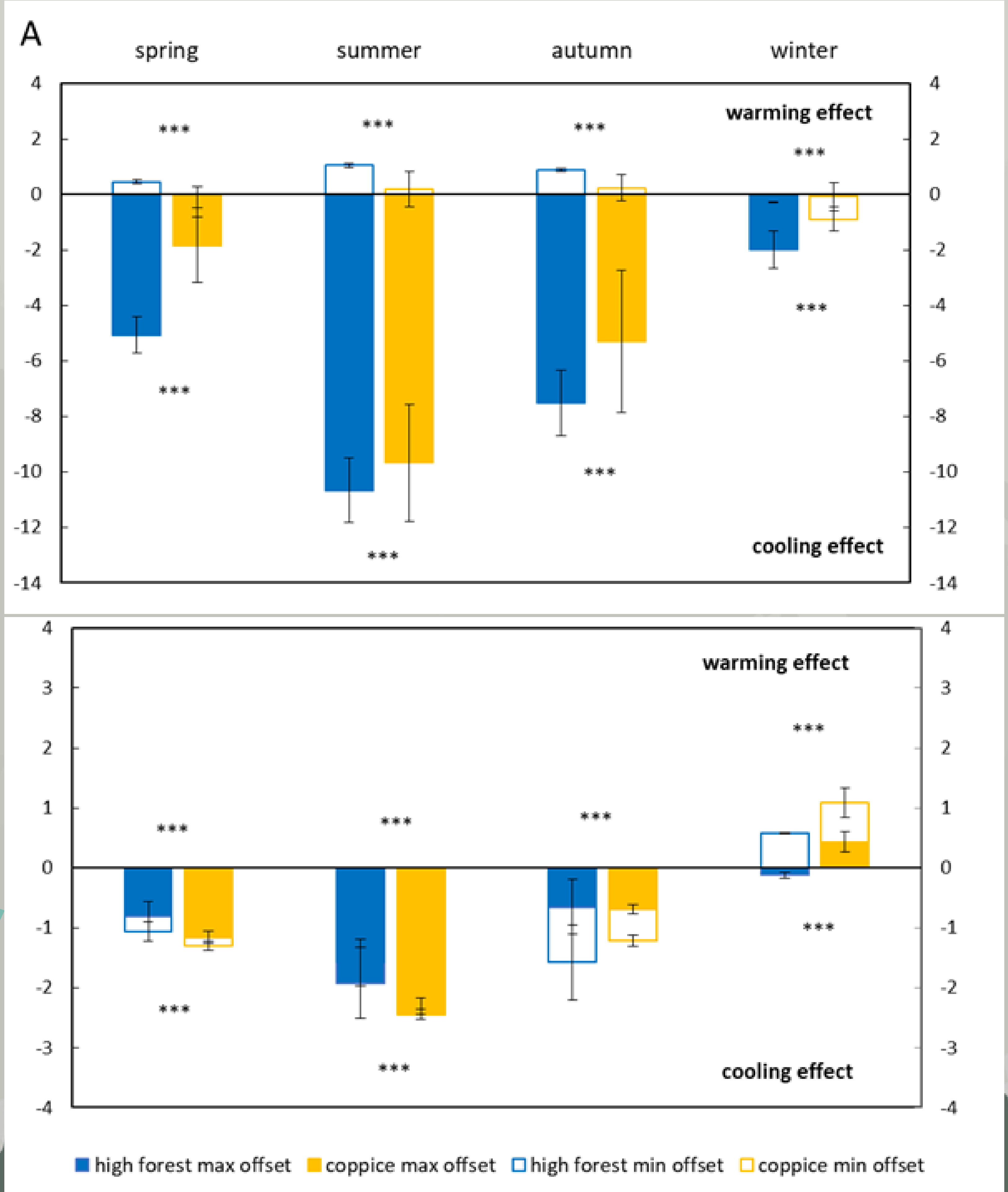
3. METHODS DATA ANALYSIS

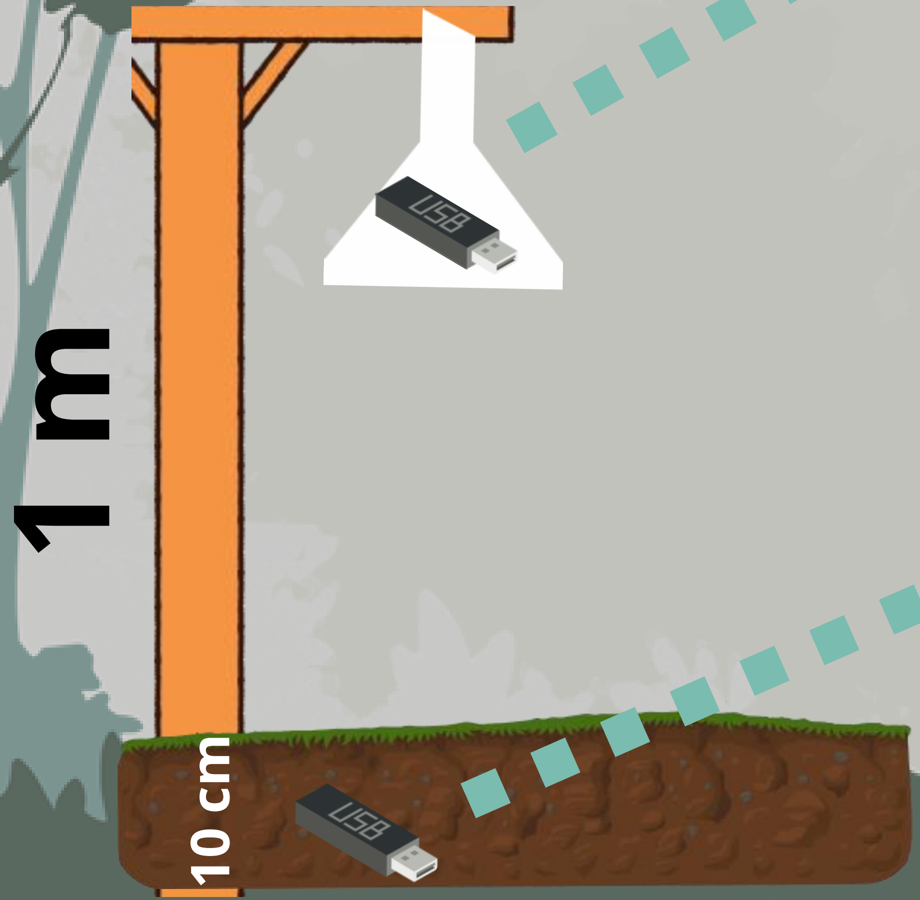
variable	measure	statistic
•Microclimate buffering	•Max and min T offsets	ANOVA of offset comparisons (n=6)
•Taxonomic diversity and composition	•SR, H', J; % of different forest guilds (Heinken), Ellenberg indexes	Linear mixed model (n=24; biomass n=48): y~ forest management + 1|plot (*lme* function with Gaussian distribution; SR *lmer* function with Poisson distribution)
•Phylogenetic structure and diversity	•PD, MNTDses, MPDses	
•Functional trait diversity	•SLA, LDMC, vegH, repH, seedmass (cwm, rao, ses)	
•Biomass productivity	•Herb, woody and total biomass	Ordinary least squares regression analysis between SR and productivity

4. RESULTS

HOW IS FOREST TEMPERATURE BUFFERING CAPACITY IMPACTED BY COPPICING?







4. RESULTS

WHAT ARE THE EFFECTS ON UV TAXONOMIC DIVERSITY?

High forest

Coppice

mixed model results:
y~forest management+1|plot

SPECIES RICHNESS — Coppice: +4.6 ***

FOREST SPECIALIST ABUNDANCE (HEINKEN CLASSIFICATION) — High forest: +80% ***

LIGHT REQUIREMENTS ACCORDING ELLENBERG INDEX — Coppice: +0.58 ***

Malus florentina

Anemone nemorosa

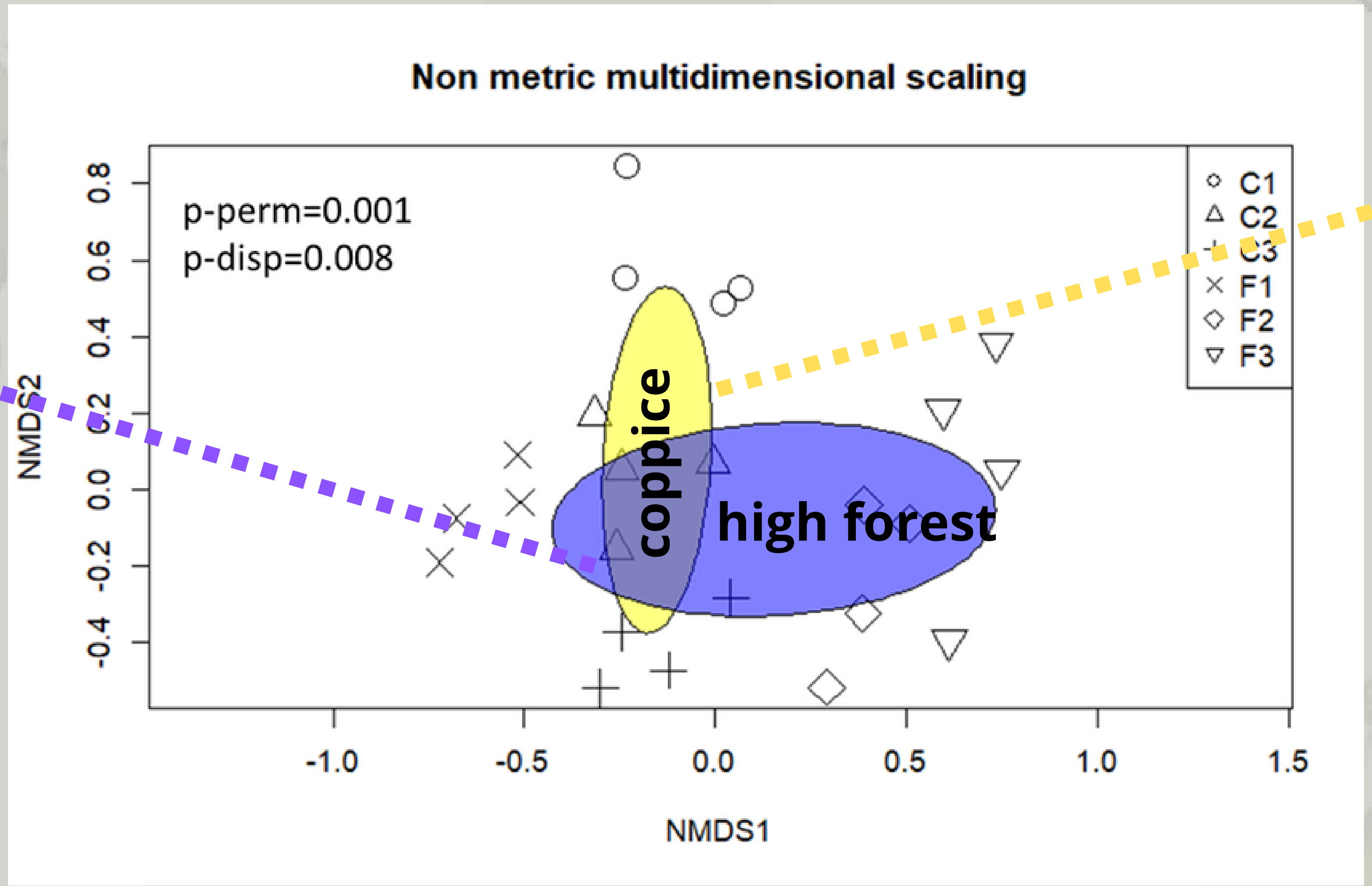
Physospermum cornubiense

Pyrus pyraster

Carpinus betulus

Ruscus aculeatus

indicator species



indicator species

Poa nemoralis

Carex pallescens

Calluna vulgaris

Genista pilosa

Cruciata gkabra

Viola alba

4. RESULTS

WHAT ARE THE EFFECTS ON UV PHYLOGENETIC DIVERSITY?

High forest | **Coppice**

ses

* +0.72 ↑	STANDARDIZED PHYLOGENETIC DISTANCE	↓
+0.11	STANDARDIZED MEAN PAIRWISE DISTANCE	
+0.46	STANDARDIZED MEAN NEAREST TAXON INDEX	

no ab.

+0.41	STANDARDIZED MEAN PAIRWISE DISTANCE	
*** +0.99 ↑	STANDARDIZED MEAN NEAREST TAXON INDEX	↓

Coppice → **clusterization in the phylogenetic tree**

mixed model results:
y~forest management+1|plot

4. RESULTS WHAT ARE THE EFFECTS ON UV PHYLOGENETIC DIVERSITY?

High forest

Coppice

CMW

High forest	Trait	Coppice
	SPECIFIC LEAF AREA	+0.96
	LEAF DRY MATTER CONTENT	+12.32 *
+1.74	VEGETATIVE HEIGHT	
+0.22	REPRODUCTIVE HEIGHT	
+10.69	SEEDMASS	

Rao.ses

High forest	Trait	Coppice
	SPECIFIC LEAF AREA	+0.23
* ** +0.63	LEAF DRY MATTER CONTENT	
	VEGETATIVE HEIGHT	+0.62
	REPRODUCTIVE HEIGHT	+0.64
+0.04	SEEDMASS	

ongoing adaptation processes

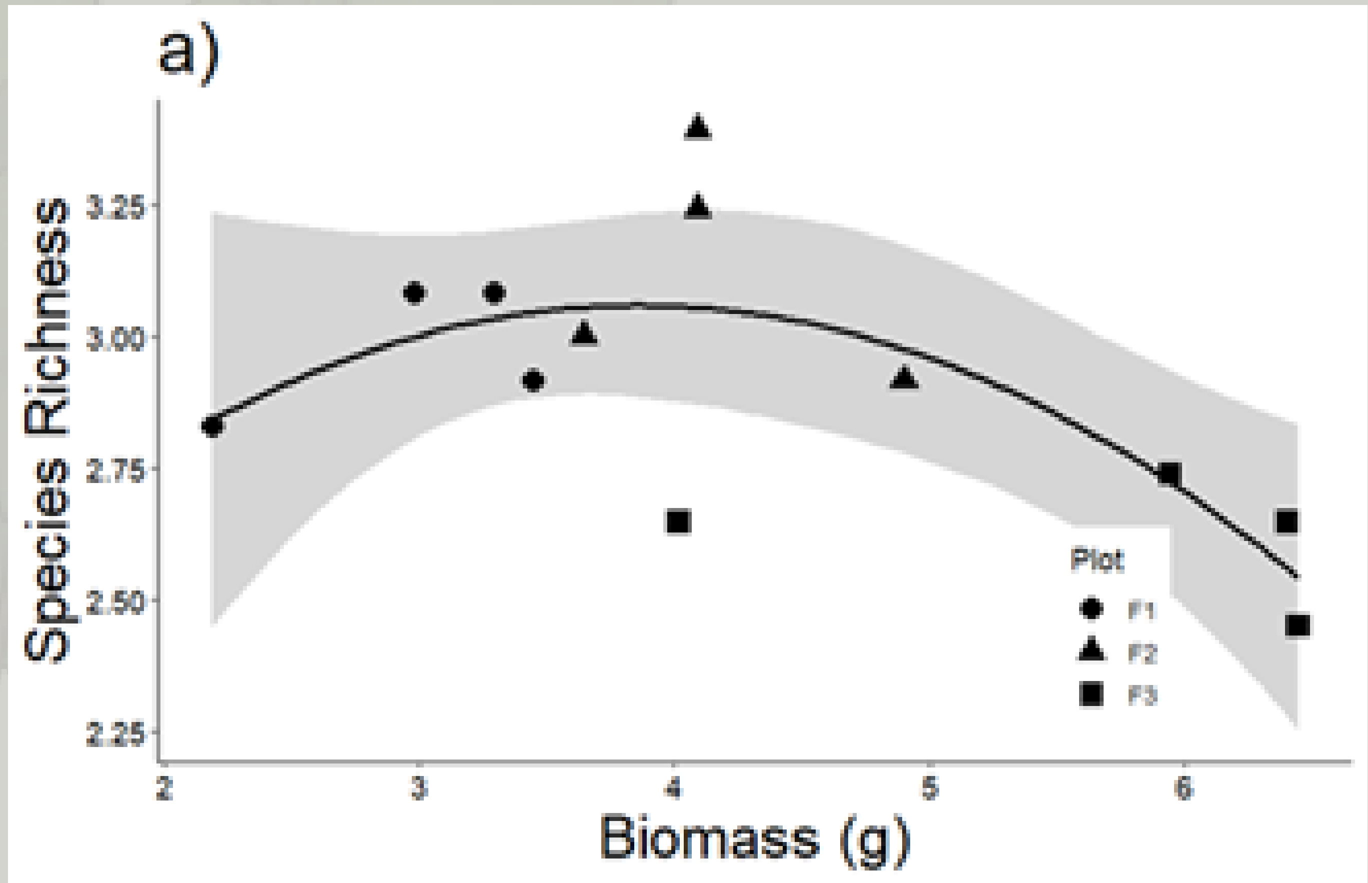
mixed model results:
y~forest management+1|plot

4. RESULTS WHAT ARE THE EFFECTS ON UV PRODUCTIVITY?

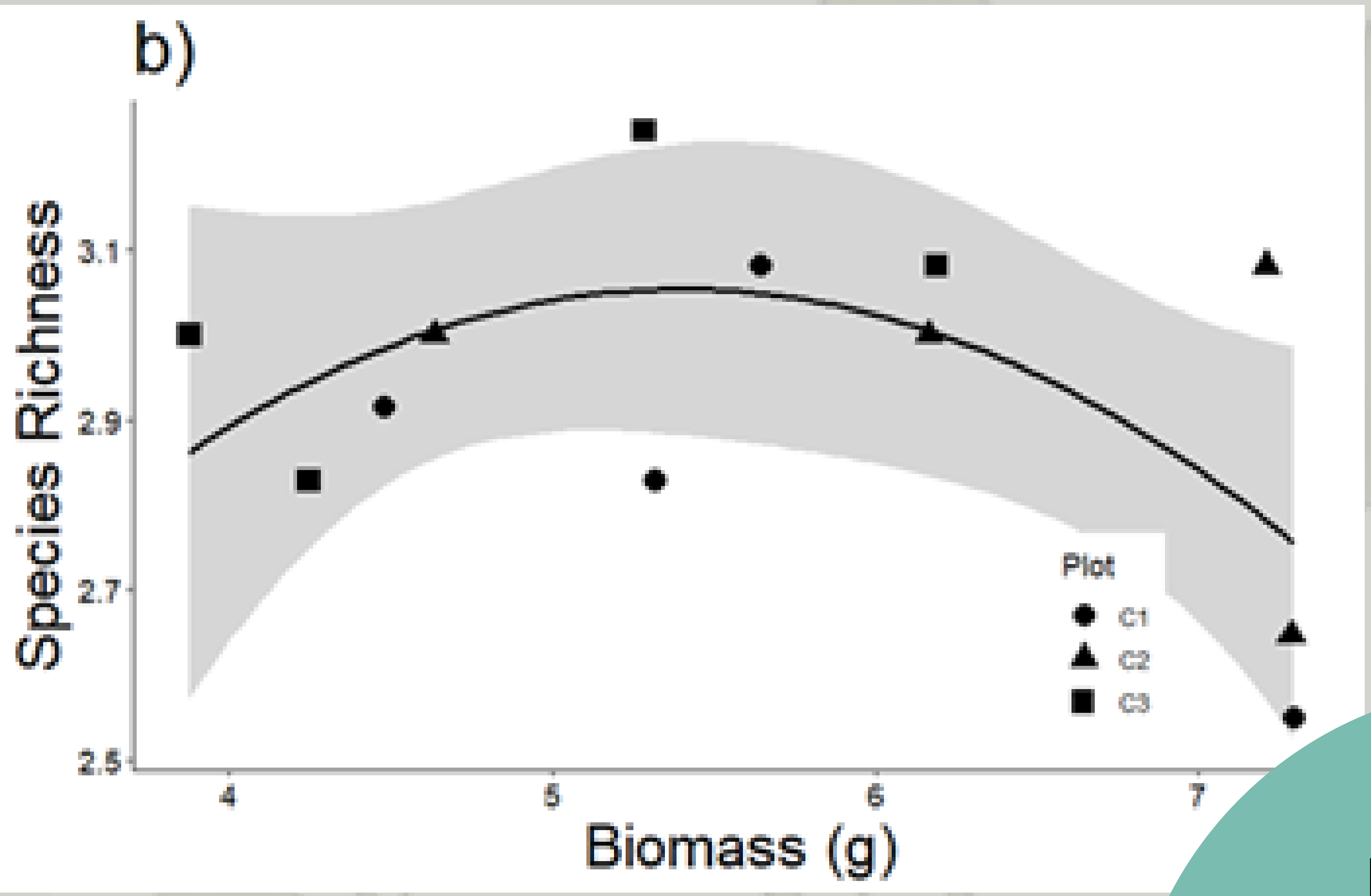
High forest

Coppice

TOTAL BIOMASS +60% ***



$R^2=0.44$ $p<0.001$



$R^2<0.3$ p=n.s.

large SR variation at the higher productivity levels

Not monotonic linear as in central Europe but unimodal humped-back model (different light regime)

Conclusions

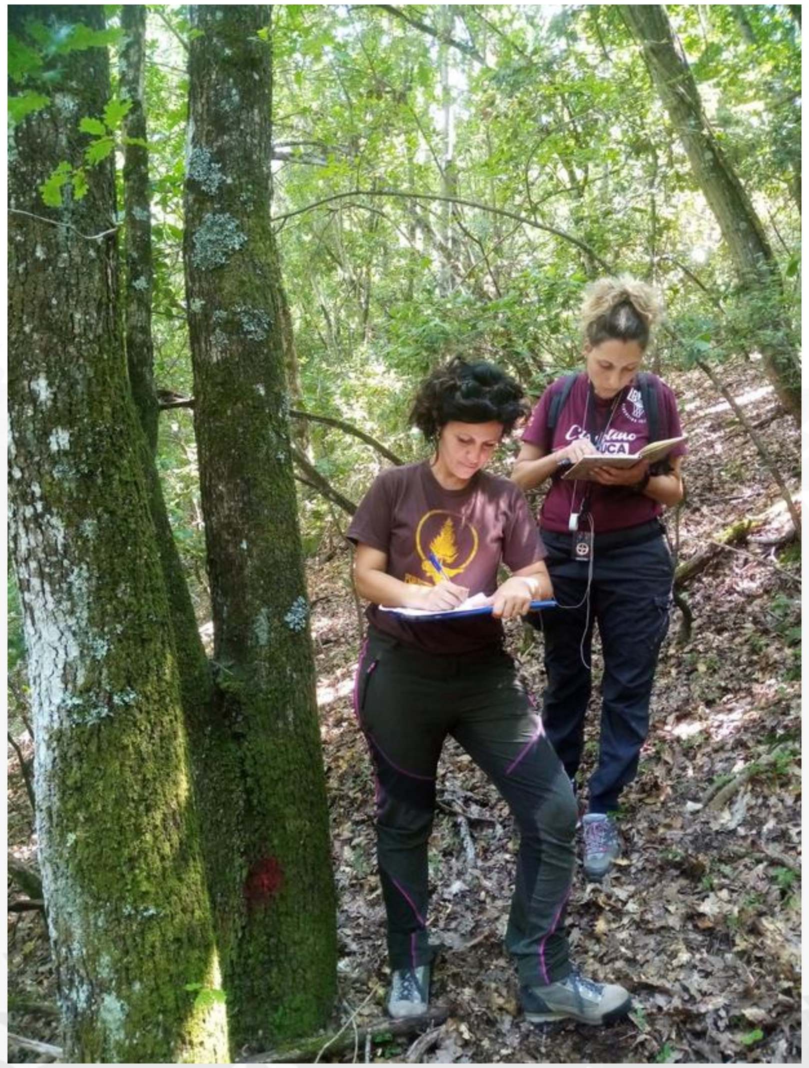
- Coppicing reduces the temperature buffering capacity of the forest at the air level while increasing it at soil level

- Taxonomic, phylogenetic and functional diversities are differently affected.

- The positive effect of coppice on UV productivity is confirmed, but we found a deviation from a consistent SR-P unimodal relationship compared with high forests.
- More studies on larger spatial and ecological scales would be needed to better explore the SR-P relationship in Mediterranean forests and the influence of management

Take home message

Need to consider all of aspects of diversity for a holistic understanding of coppicing impacts and a more conscious application of this practice in Mediterranean oak woodlands affected by climate warming



Thank you

elisa.carrari@unifi.it

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