FACULTY OF BIOSCIENCE ENGINEERING

DEPARTMENT OF ENVIRONMENT
FOREST & NATURE LAB

FORESTREPLOT: A DATABASE OF FOREST HERB LAYER RESURVEY PLOTS

Pieter De Frenne, Lander Baeten, Kris Verheyen, Markus Bernhardt-Römermann, Radim Hedl & Don Waller

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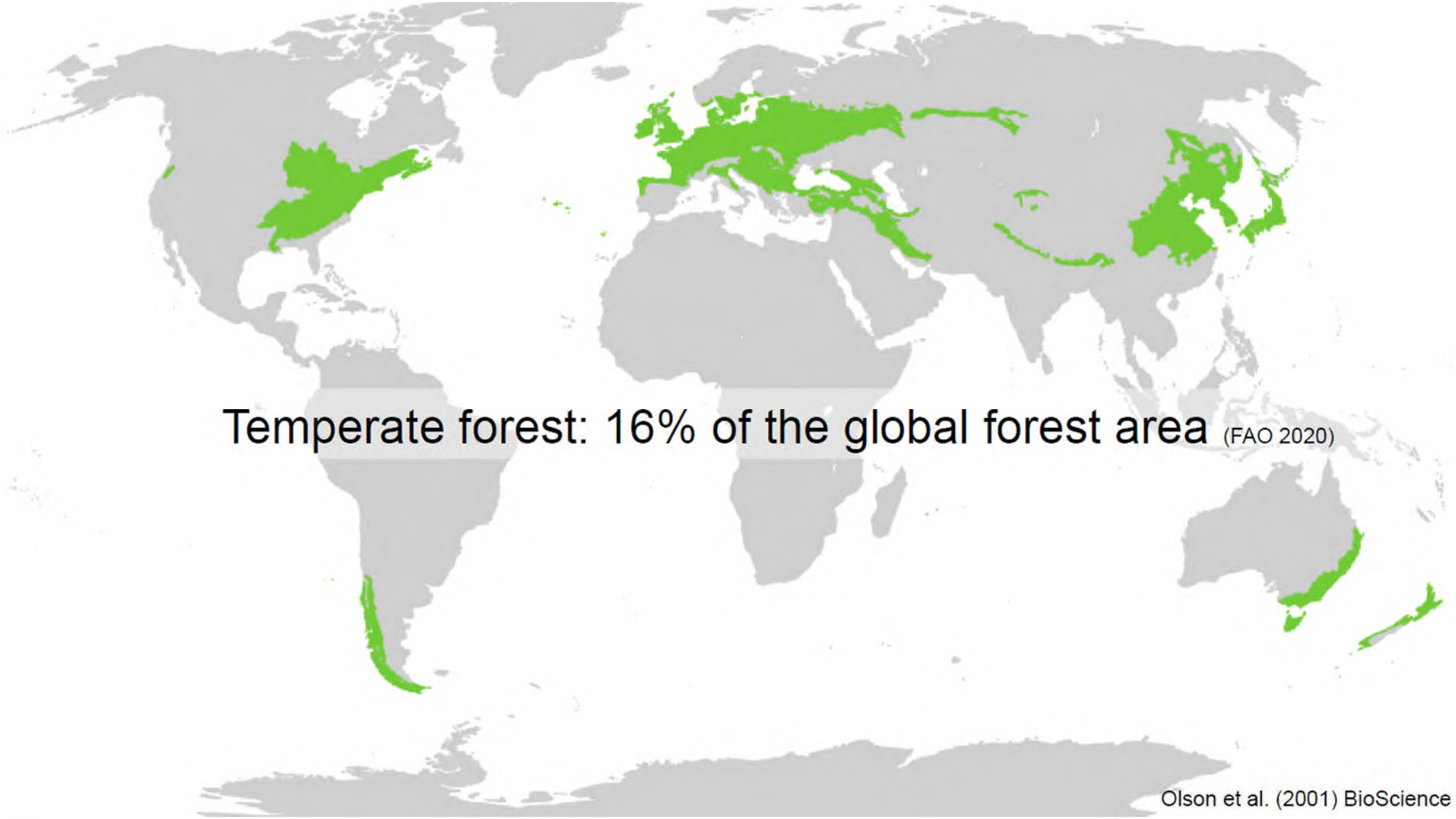
ForNa Lab

FOCUS ON TEMPERATE FORESTS



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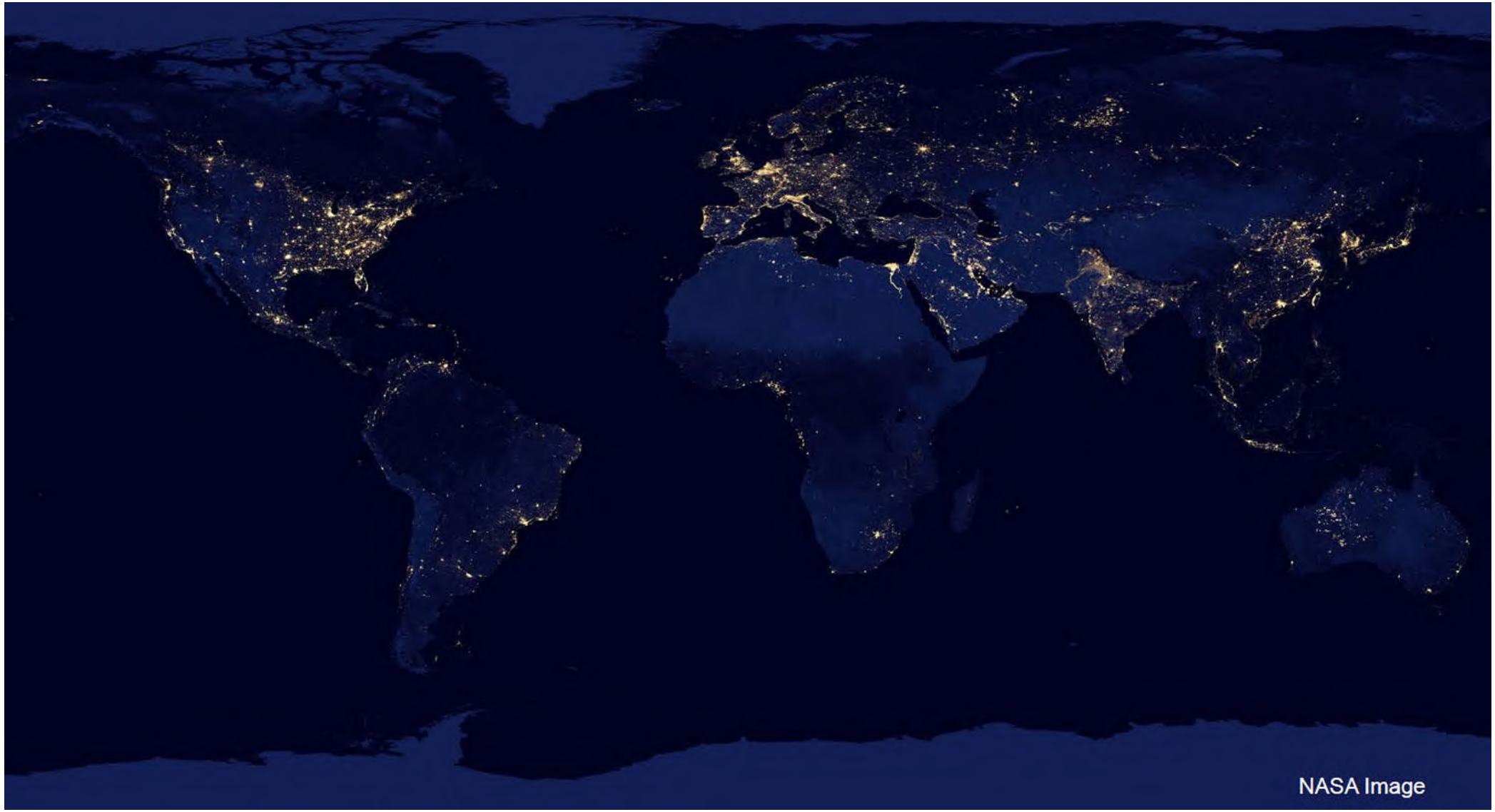
FOCUS ON TEMPERATE FORESTS



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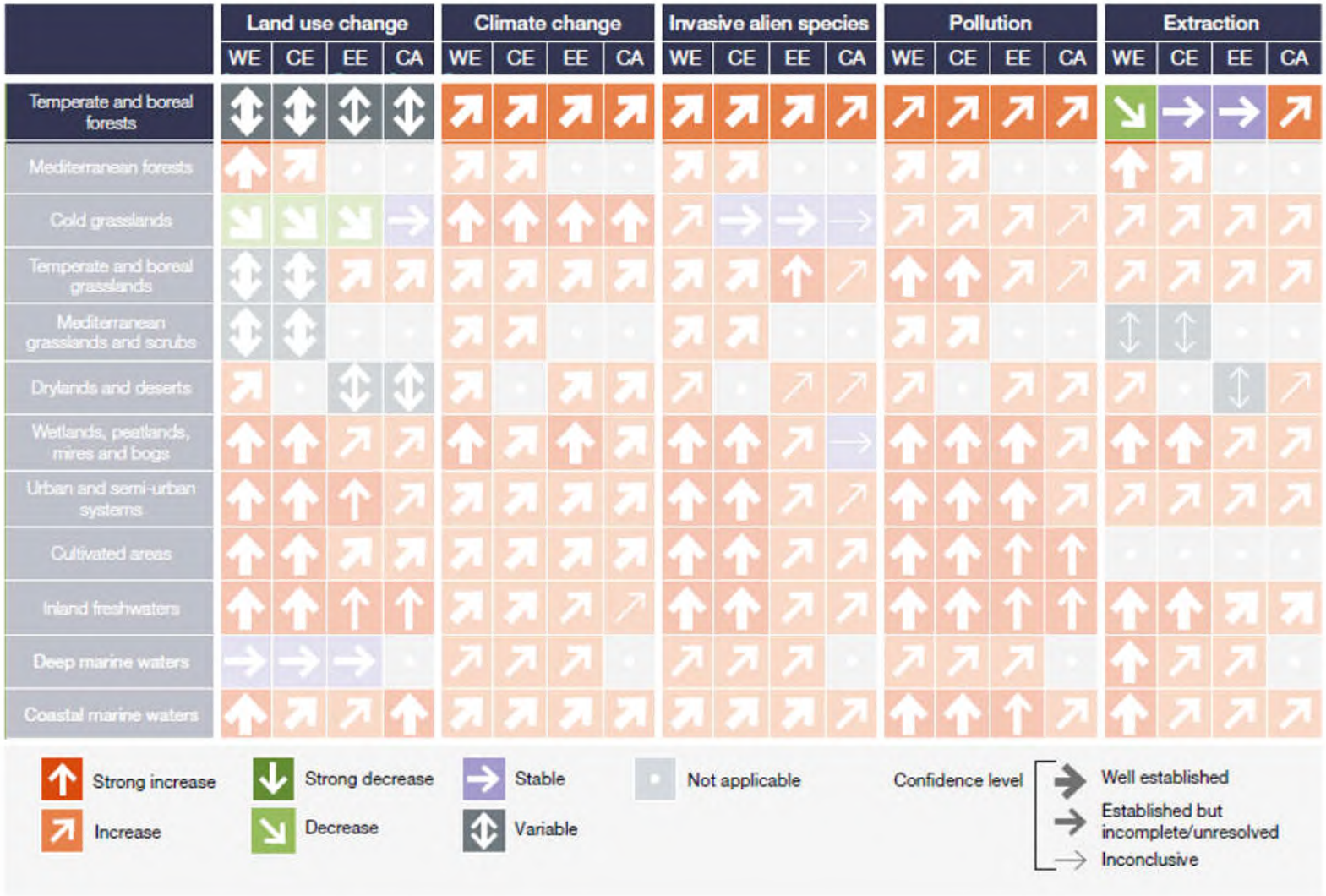
FOREST BIODIVERSITY AND GLOBAL CHANGE

Trends in direct drivers of biodiversity and nature's contributions to people in the last 20 years. (Europe and Central Asia)



IPBES 2018

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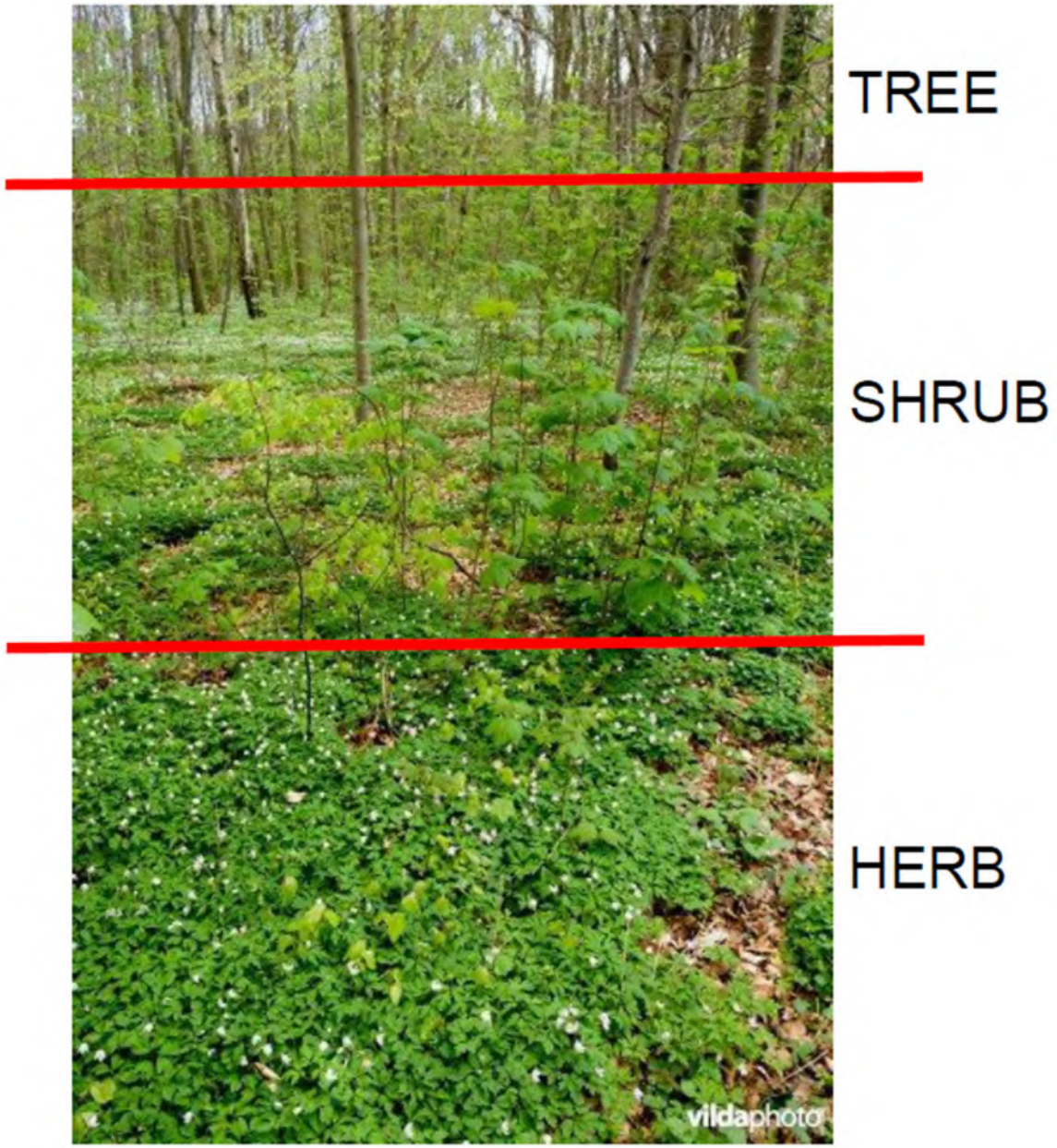
THE HERB LAYER

Trees > 7 m

Trees and shrubs 1 – 7 m

Vascular plants < 1 m
(incl. trees and shrubs)



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THE IMPORTANCE OF THE HERB LAYER

> 80 % vascular plant diversity

(Gilliam et al. 2014)

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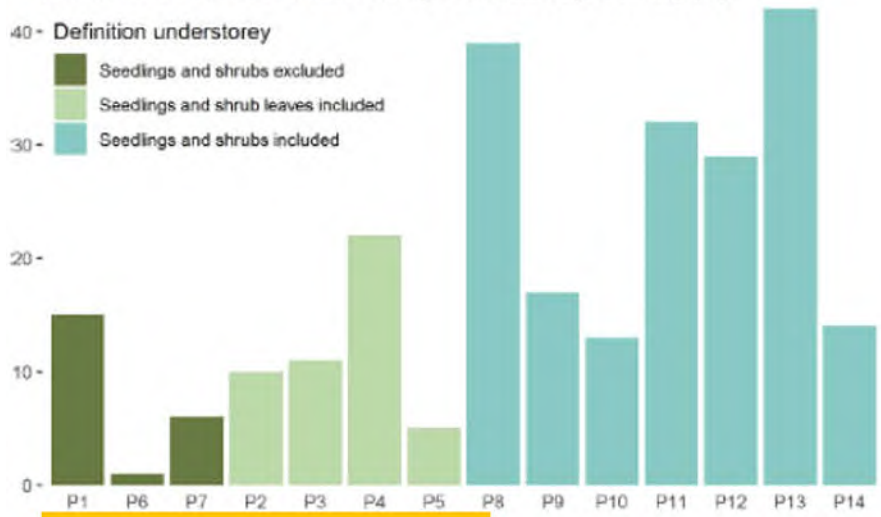
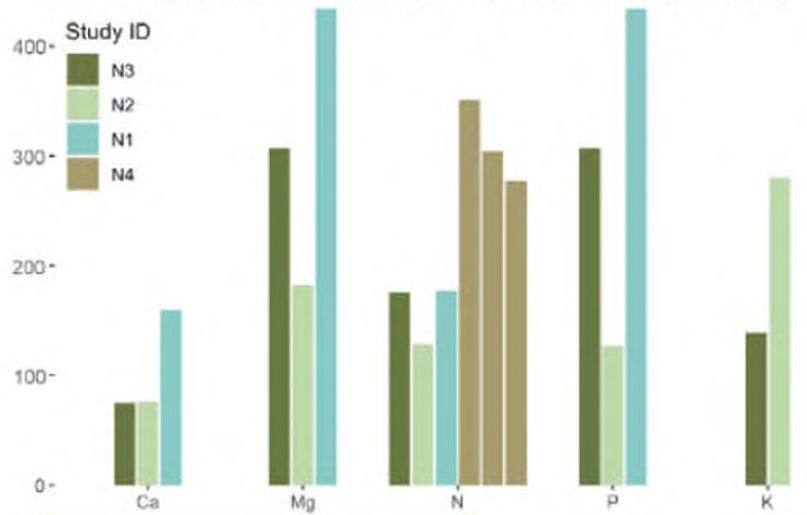
THE IMPORTANCE OF THE HERB LAYER

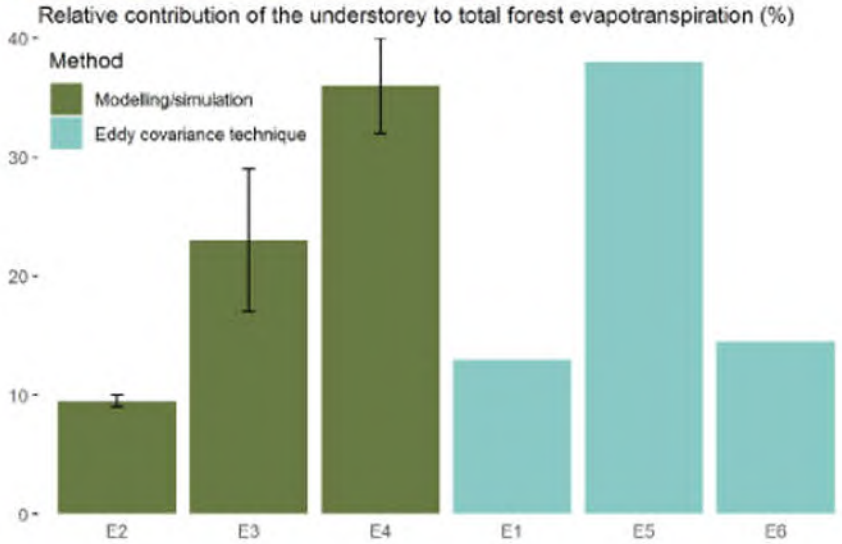
Productivity



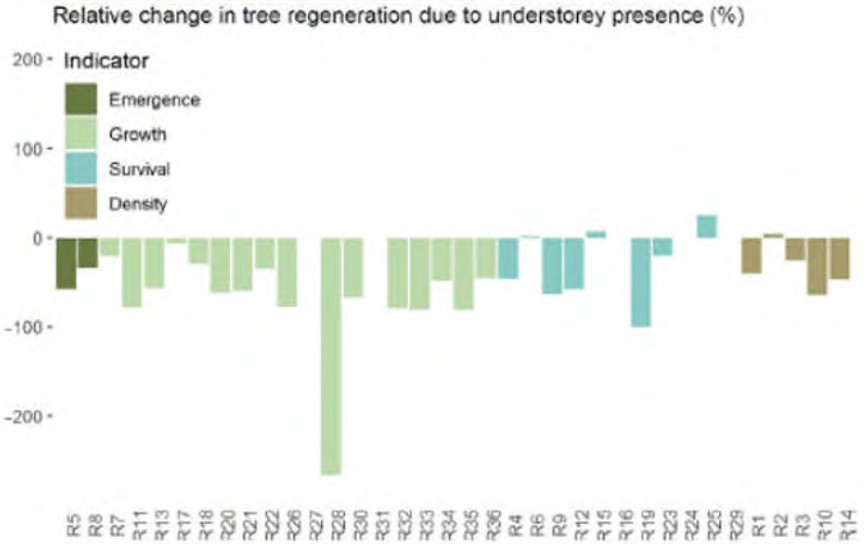
Nutrient cycling



Evapotranspiration



Tree regeneration



Landuyt et al. (2020) *Global Change Biol.*

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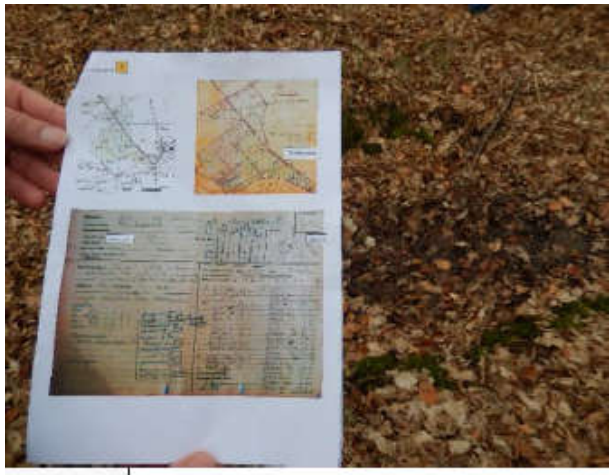
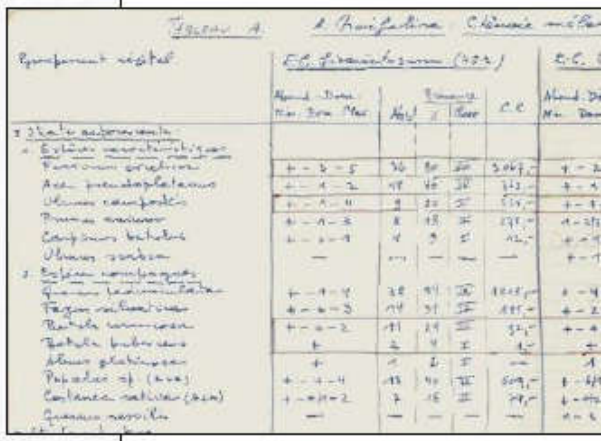
RESURVEYS





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+ tree and shrub layer

…BUT ALSO TREE & SHRUB DATA

Trees > 7 m

Trees and shrubs 1 – 7 m

Vascular plants < 1 m
(incl. trees and shrubs)

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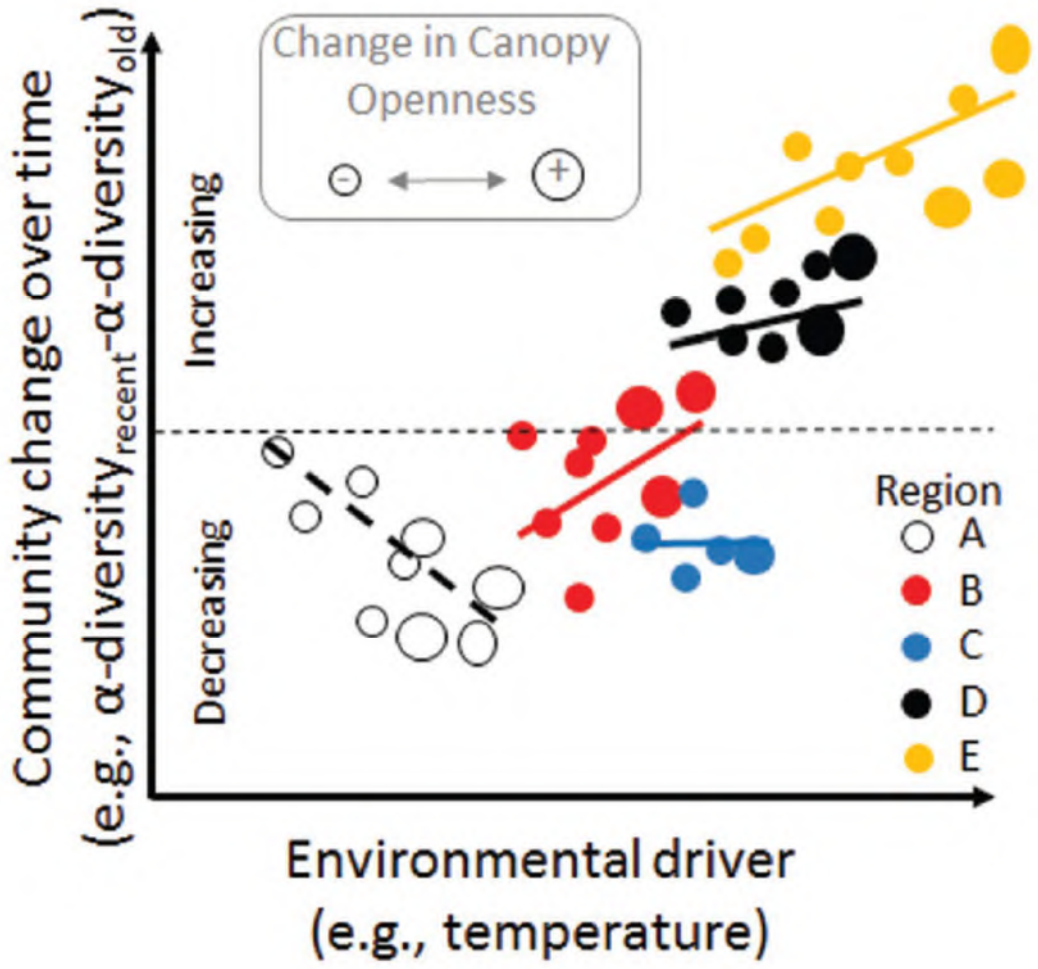
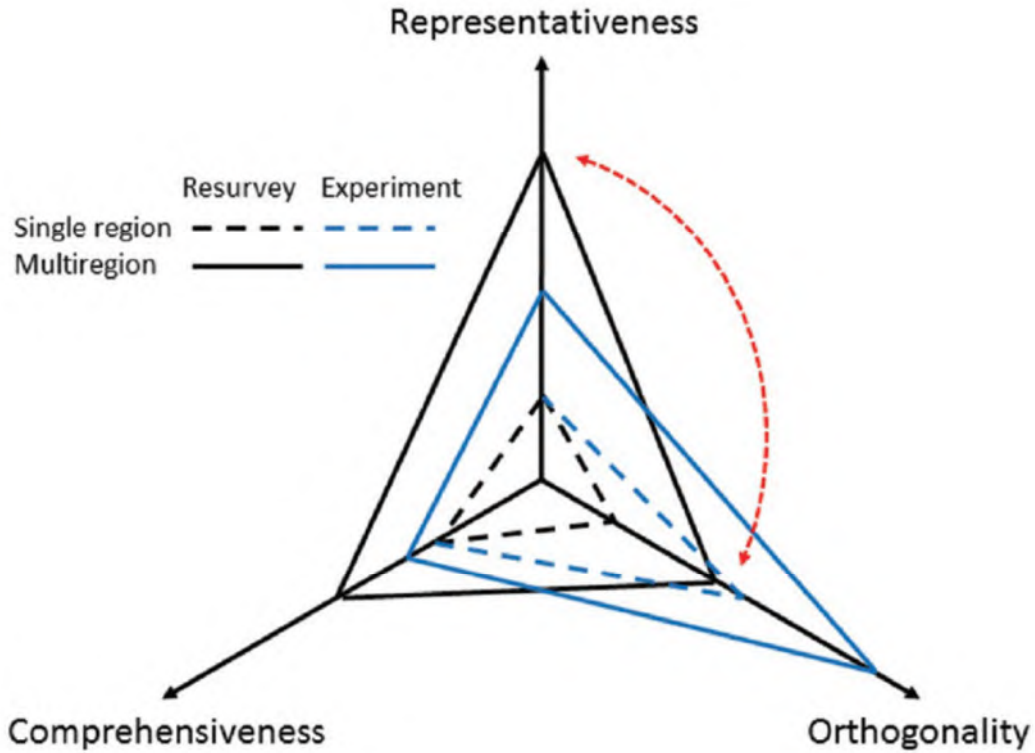
THE IMPORTANCE OF RESURVEYS





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Verheyen et al. (2017) *BioScience*

CURRENT STATUS OF FORESTREPLOT

- 5577 plots (of which 523 from NA & 5054 from EUR)

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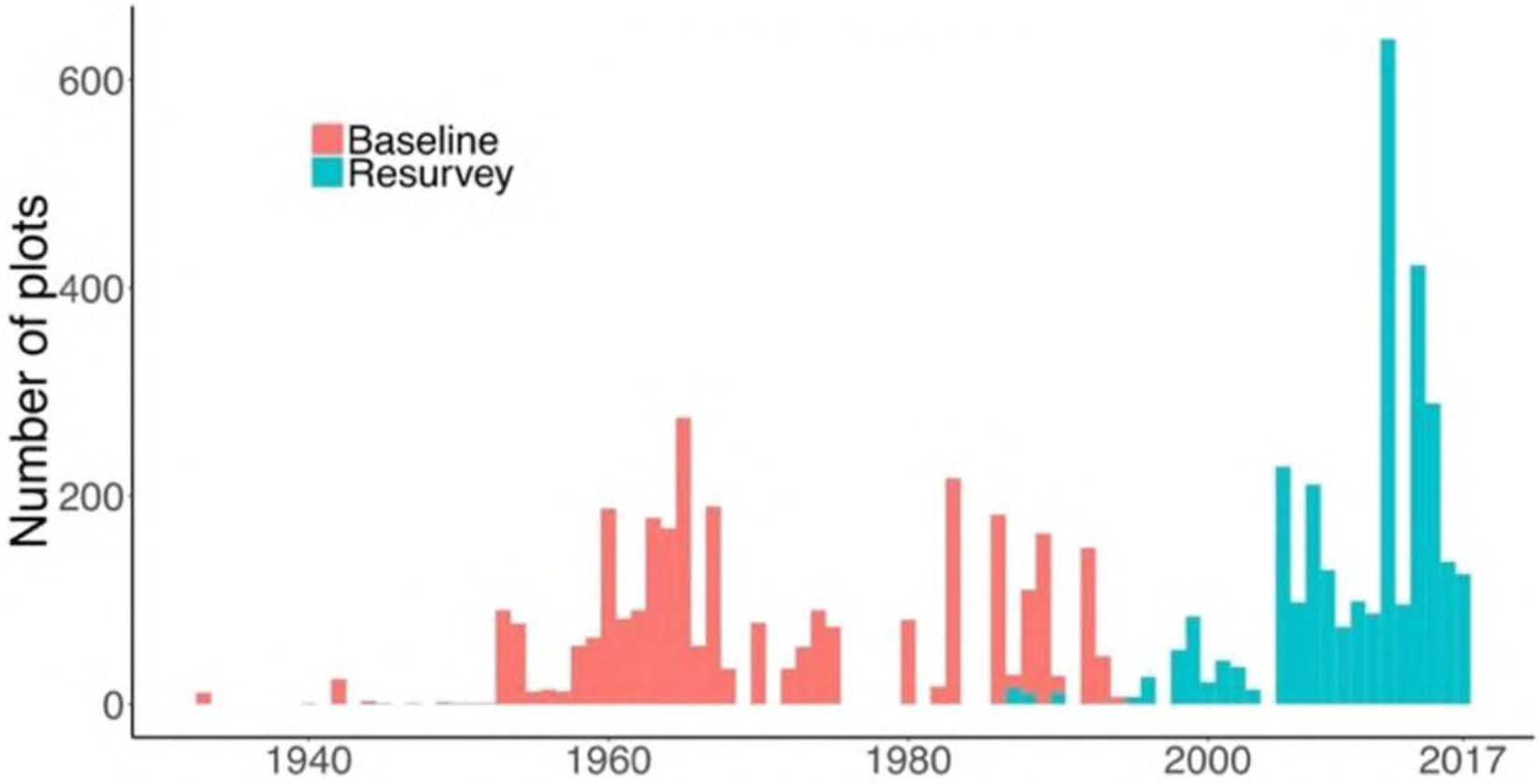
www.forestREplot.ugent.be

CURRENT STATUS OF FORESTREPLOT

- Baseline survey ~1960s (1933-2002)
- Resurvey ~2010s (1987-2023)
- Median time interval ~40 years



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CURRENT STATUS OF FORESTREPLOT

- Elevations 5 – 1277 m
- Plot size mostly 100 – 400 m²
- Permanent and semi-permanent
- Mostly ancient forest
- Often part of Natura2000

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MANAGEMENT COMMITTEE

- Don Waller (Wisconsin-Madison)
- Markus Bernhardt-Römermann (Jena)
- Radim Hedl (Brno)
- Lander Baeten (Ghent)
- Kris Verheyen (Ghent)
- Pieter De Frenne (Ghent)






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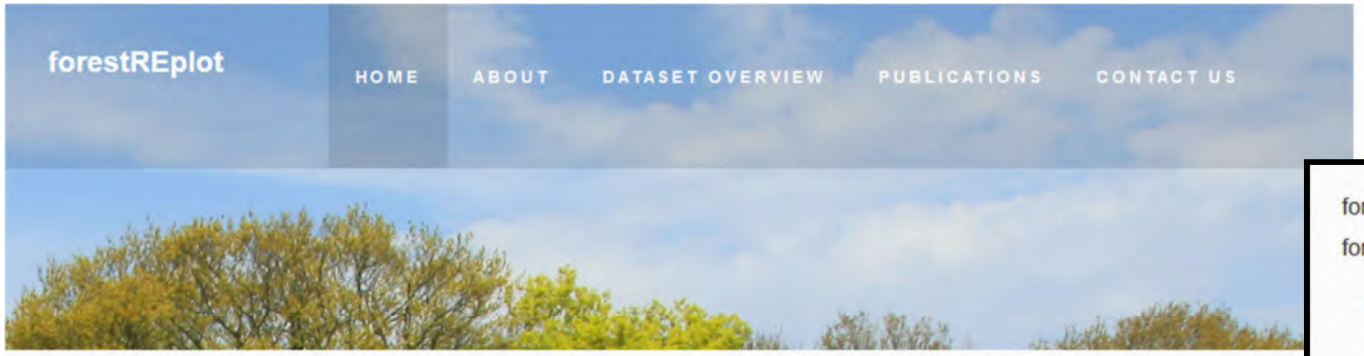
SUITABLE DATA?

www.forestREplot.ugent.be



Welcome to the forestREplot-website

A DATABASE OF FOREST HERB LAYER RESURVEY PLOTS

forestREplot is a database of forest herb layer resurvey plots, spread across the temperate zones of the globe.

The database is used to quantify changes in herb layer composition and forest functioning, and to assess the effects of global environmental changes such as nitrogen deposition and climate change.

READ MORE

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forestREplot aims to assess shifts in forest plant communities around the globe. To be included in the forestREplot database, data need to fulfil the following criteria:

- Plots are located in temperate forest worldwide (see map above)
- Plots are located in forest locations with a known land-use history (i.e. ancient or recent forest)
- Plots are located in semi-natural and natural forests according to the FAO definitions (e.g. exclude fertilized, heavily managed plantations)
- Number of plots and time span: about 20 plots per dataset and about 20 years between the oldest and most recent survey are the minimum requirements
- Plot size varies between 1 m^2 and 1000 m^2
- Plots should not be pseudoreplicates, i.e. distributed over a sufficiently large area
- GPS coordinates of each plot are available
- Records of all vascular plant species (presence/absence or cover/abundance) are available for each plot; at least for the herb layer, but preferably also for the shrub and tree layers
- Between the two surveys, no human-induced conversion to stand types no longer in line with the natural or semi-natural forest criteria has taken place (e.g. clearcutting and replanting with conifers on a site naturally dominated by broadleaves)

DATA OVERVIEW

DATA CONTENT AND POLICY

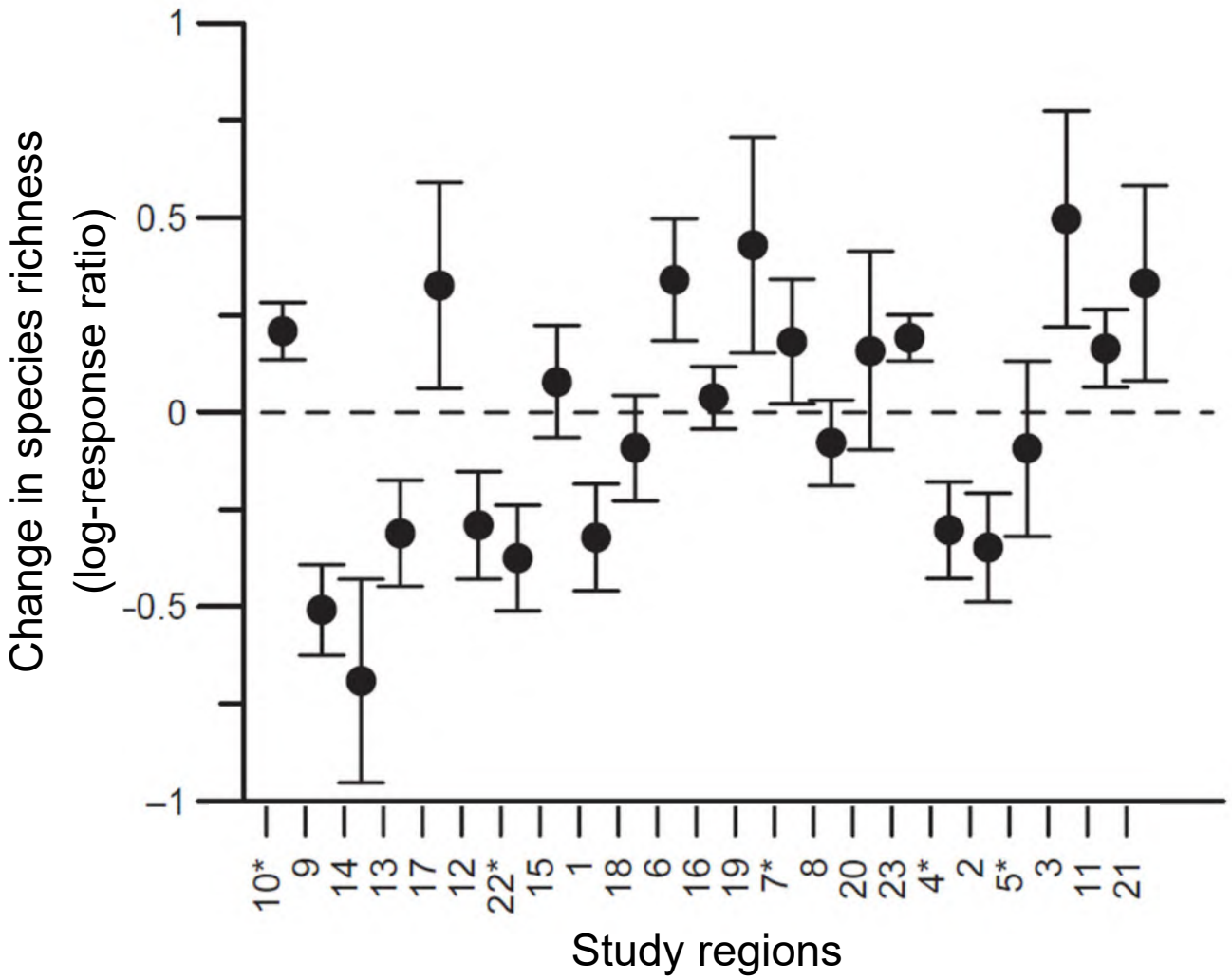
MOST COMMON SPECIES

We welcome paper proposals using the forestREplot database. If you interested to start a study under the conditions explained in the Data content and policy-document and Paper proposals-document, please fill in this template and email this to the management committee.

TEMPLATE PAPER PROPOSAL

MAIN FINDINGS: SPECIES RICHNESS

– No directional change in species richness



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Verheyen et al. (2012) *J. Ecol.*

MAIN FINDINGS: SPECIES RICHNESS

– Follow-up study with more regions (low N-dep.)

	Estimate	SE	*t*-value	p-value
Species richness (overall p-value <0.001, τ^2 = 0.04, r^2 = 0.488)				
Intercept [decreasing game density]	0.278	0.09	3.02	**0.006**
Game density	−0.217	0.05	−4.43	**0.000**
Changes in game density [stable]	−0.281	0.12	−2.33	**0.029**
Changes in game density [increase]	−0.316	0.11	−2.75	**0.012**
Accumulated N-deposition at baseline survey	−0.157	0.04	−3.86	**0.001**
Changes in mean annual temperature	−0.074	0.04	−1.83	0.081
Shannon diversity (overall p-value = 0.001, τ^2 = 0.09, r^2 = 0.436)				
Intercept [decreasing game density]	0.331	0.13	2.49	**0.020**
Game density	−0.302	0.07	−4.36	**0.000**
Changes in game density [stable]	−0.372	0.17	−2.15	**0.042**
Changes in game density [increase]	−0.373	0.16	−2.29	**0.031**
Accumulated N-deposition at baseline survey	−0.191	0.06	−3.28	**0.003**
Evenness (overall p-value = 0.048, τ^2 = 0.04, r^2 = 0.080)				
Intercept	−0.004	0.03	−0.12	0.904
Accumulated N-deposition at baseline survey	−0.070	0.03	−2.05	**0.048**

Shifting baselines (larger changes in low N dep. regions)

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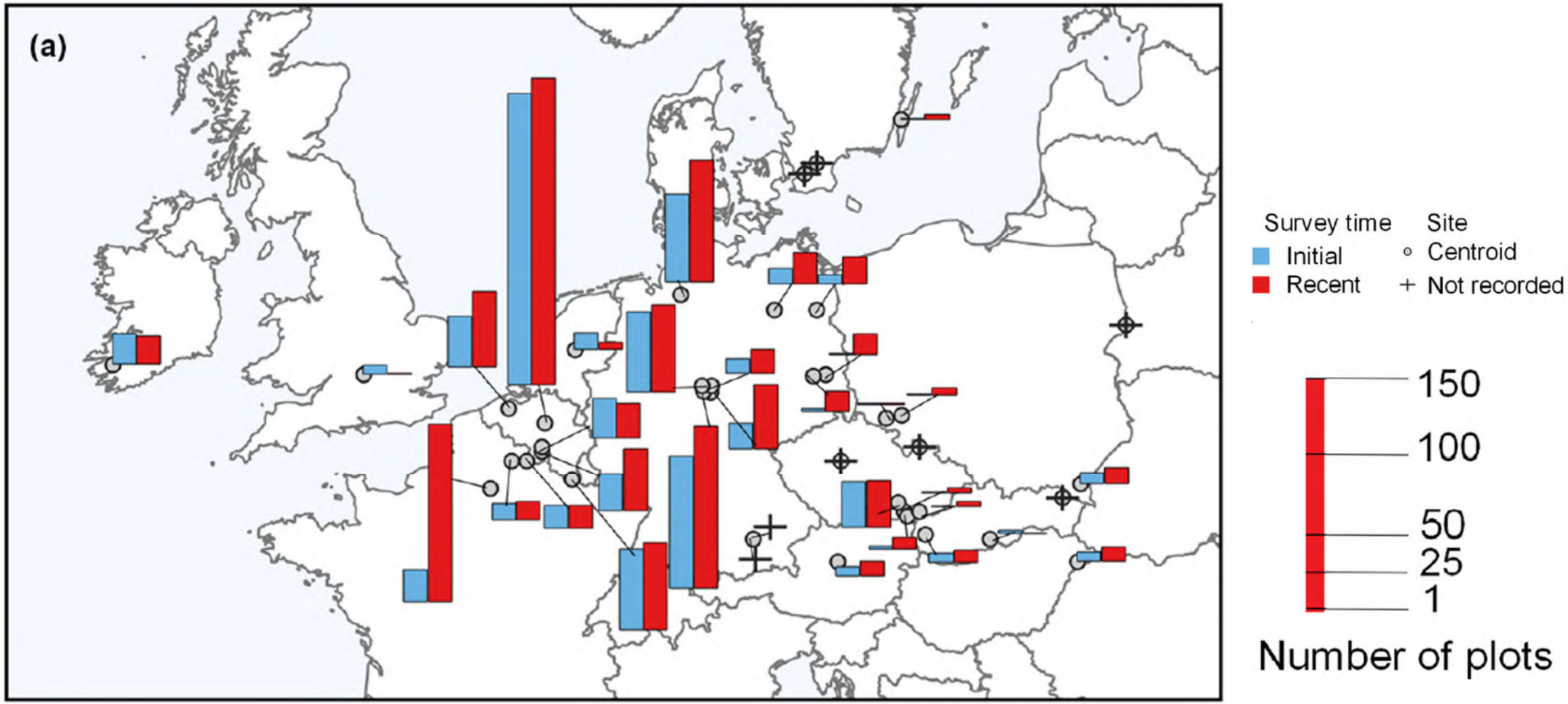
Bernhardt-Römermann et al. (2015) *Global Change Biol.*

MAIN FINDINGS: SPECIFIC SPECIES GROUPS

– Lianification



H. helix
L. periclymenum
C. vitalba

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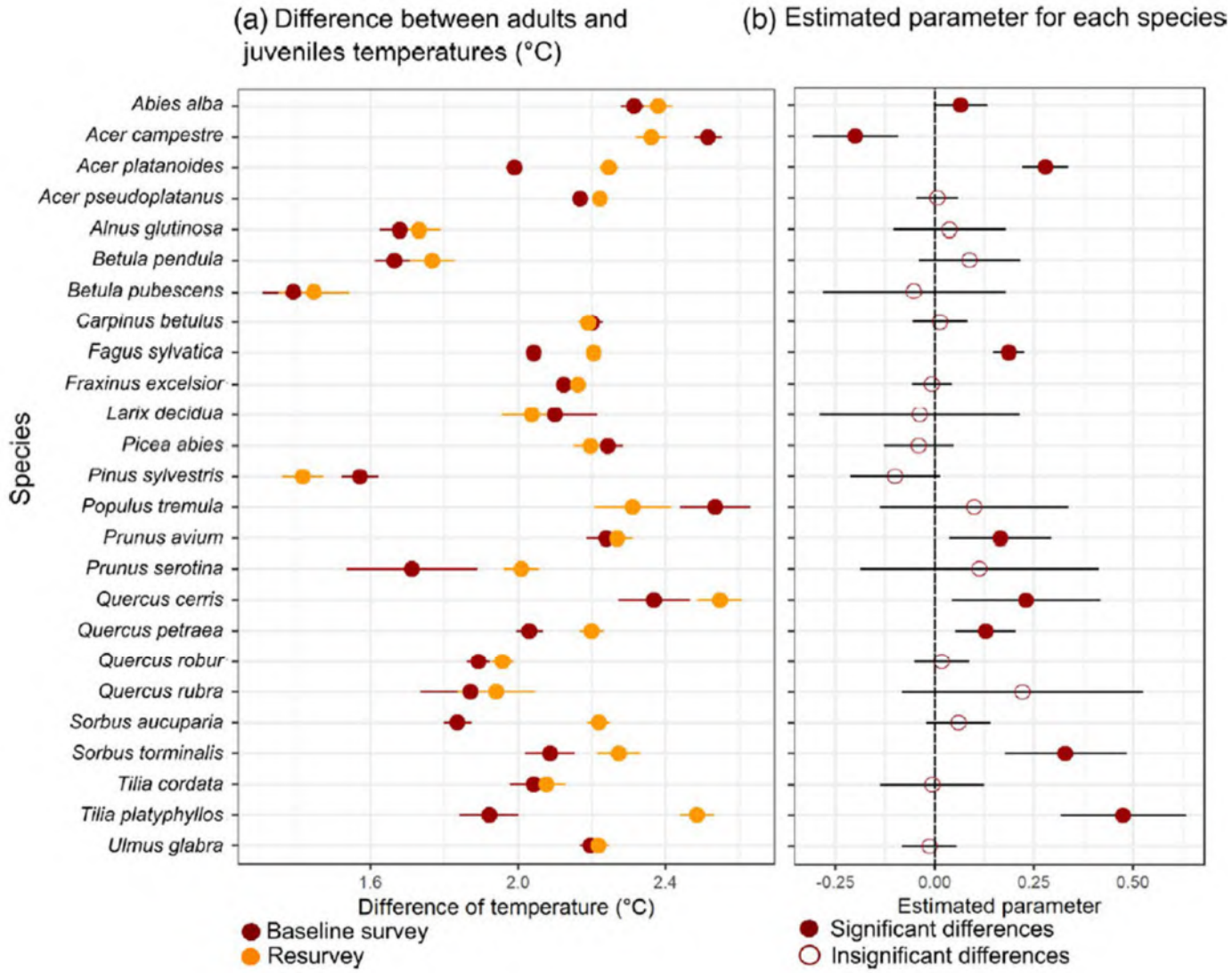
Perring et al. (2020) *Frontiers Ecol. Env.*

MAIN FINDINGS: SPECIFIC SPECIES GROUPS

– Temperatures juveniles vs adults in tree layer decouple



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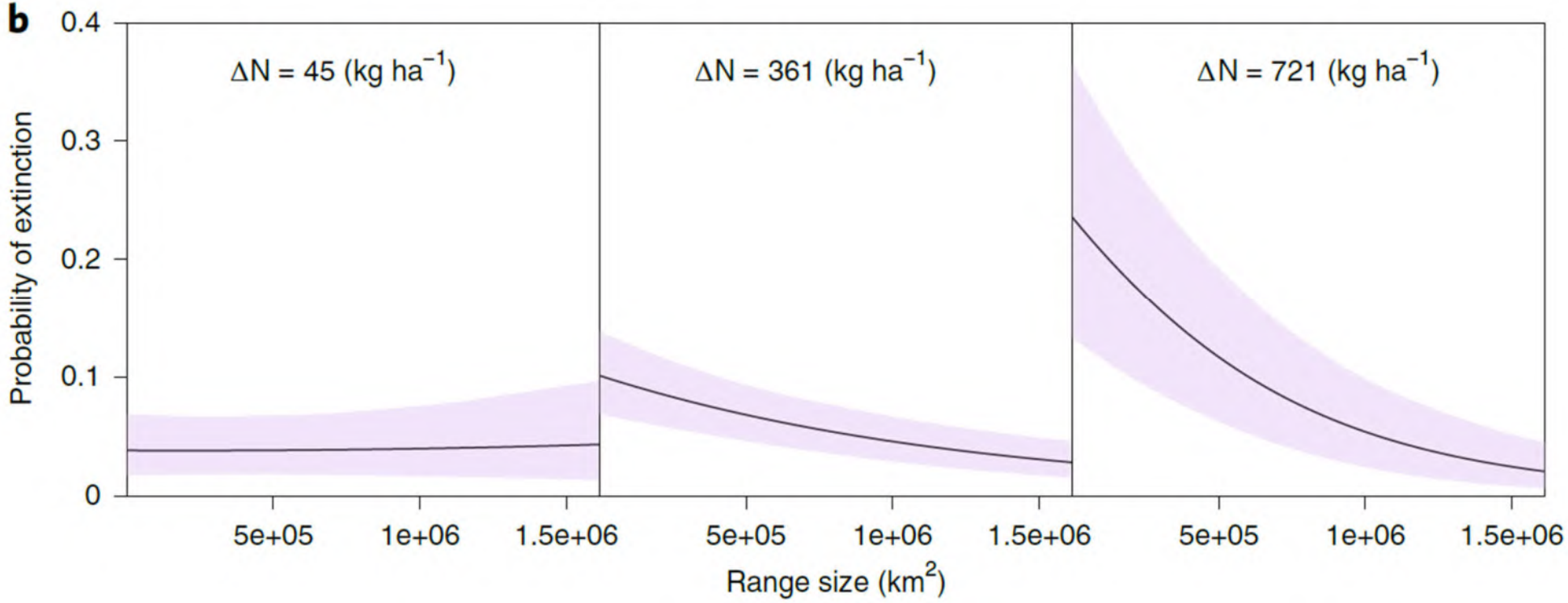
Caron et al. (2021) *J. Ecol.*

MAIN FINDINGS: COMPOSITION

– N. dep: More large-ranged species with high nitrogen demand



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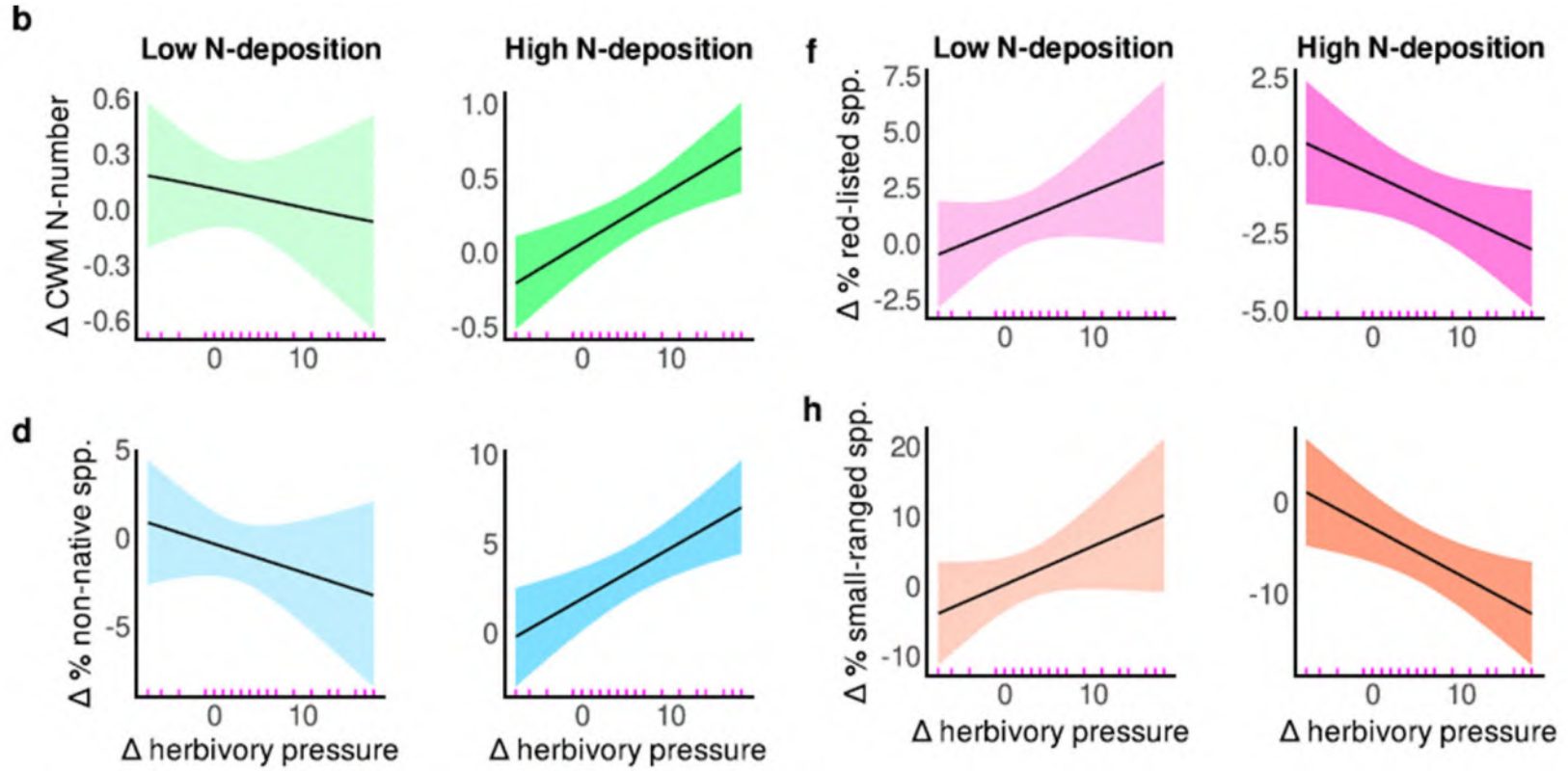
Staude et al. (2020) *Nature Ecol. Evol.*

MAIN FINDINGS: COMPOSITION

- More herbivory in high N dep. regions: species loss



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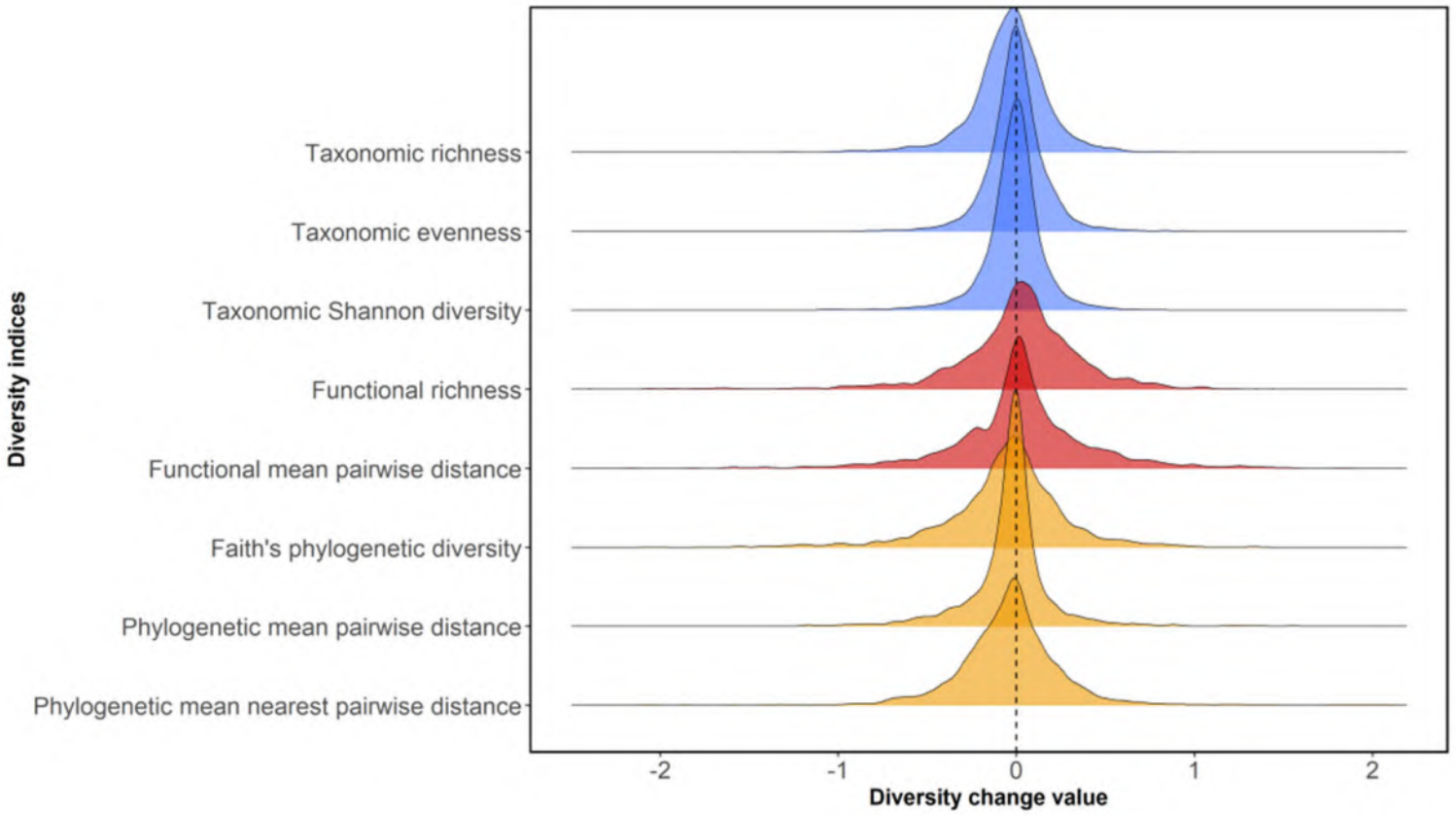
Segar et al. (2022) *Nature Comm.*

MAIN FINDINGS: COMPOSITION

– Functional & phylogenetic diversity change also centred on zero



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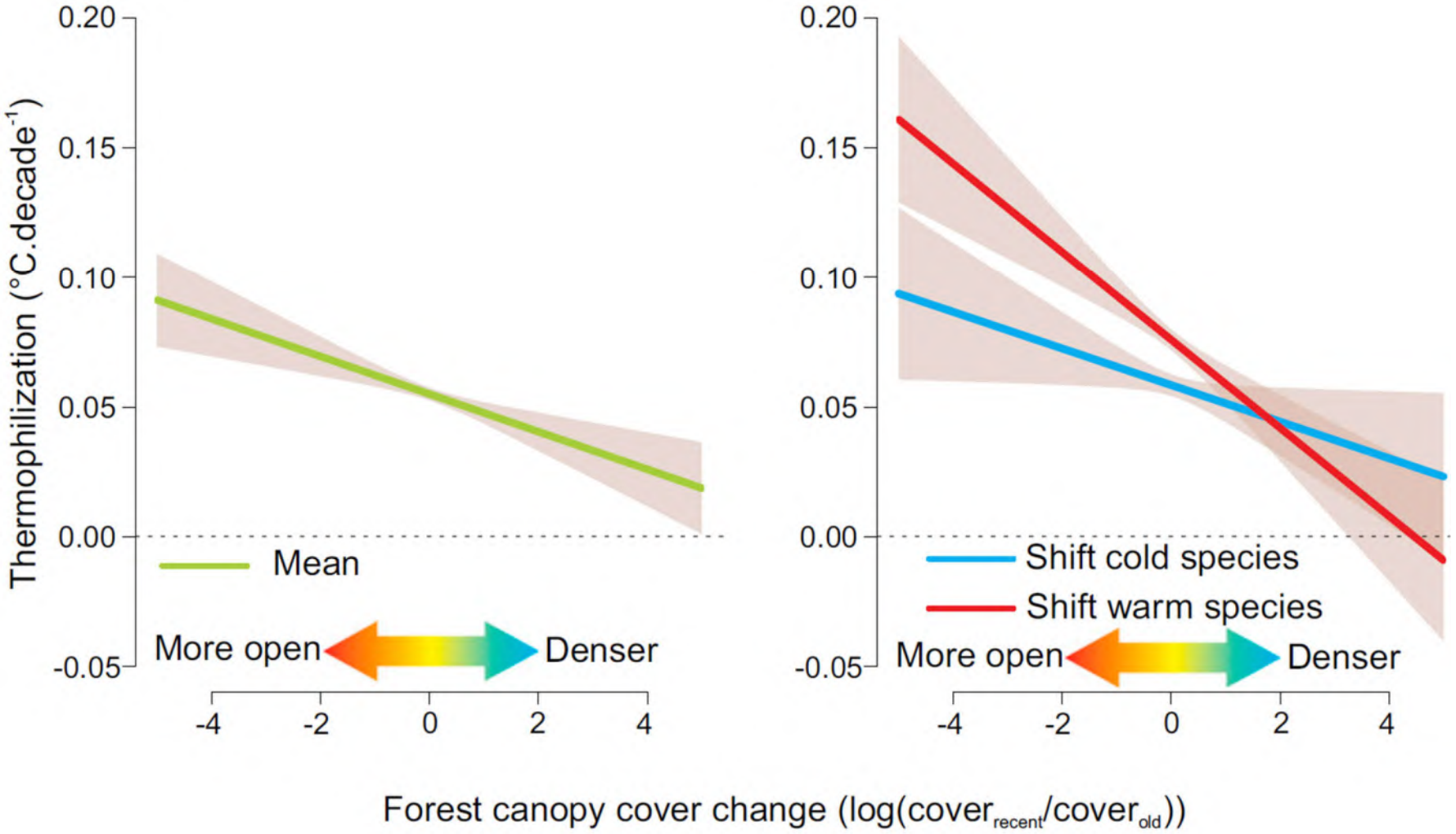
Wei et al. (submitted to *Nature Comm.*)

MAIN FINDINGS: THERMOPHILIZATION

- More thermophilization in forests that became more open over time



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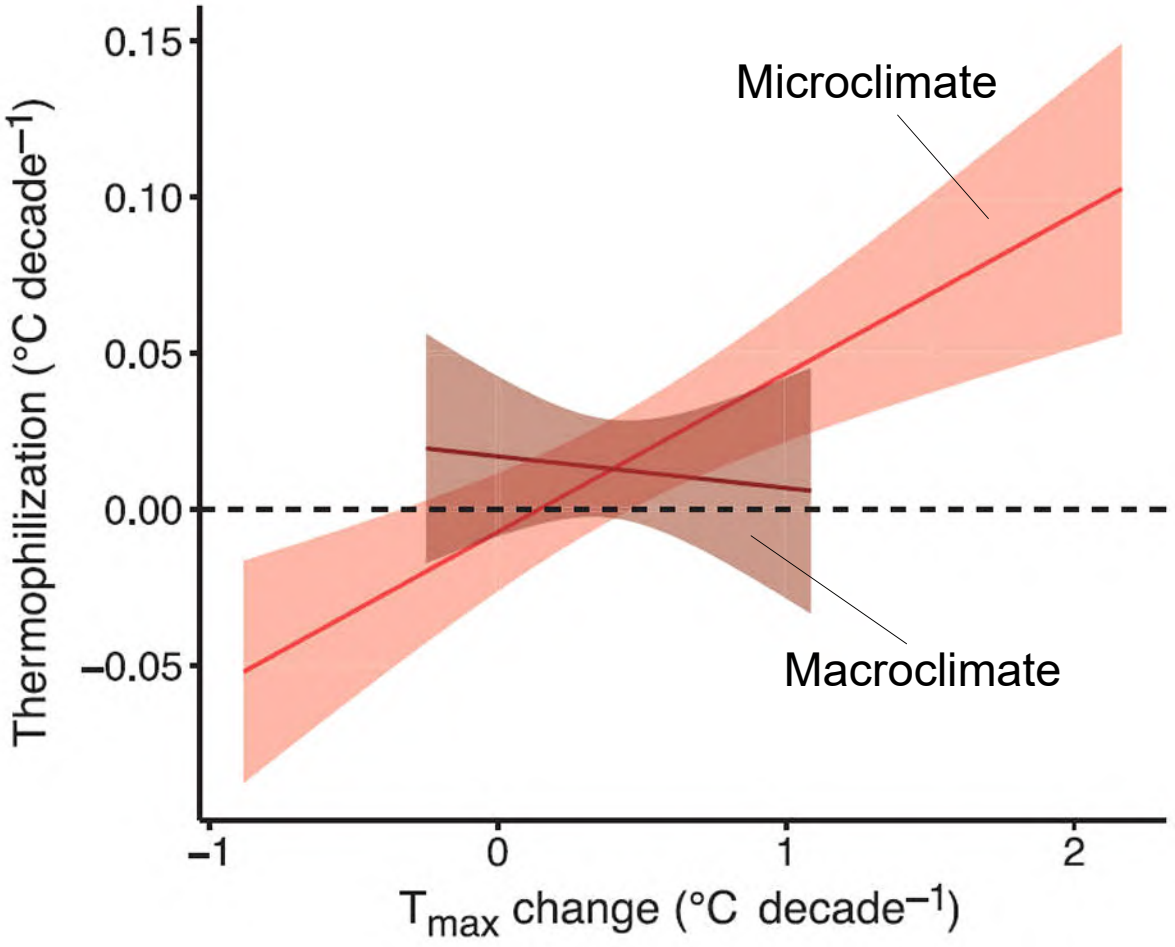
De Frenne et al. (2013) *PNAS*

MAIN FINDINGS: THERMOPHILIZATION

– …due to microclimate buffering



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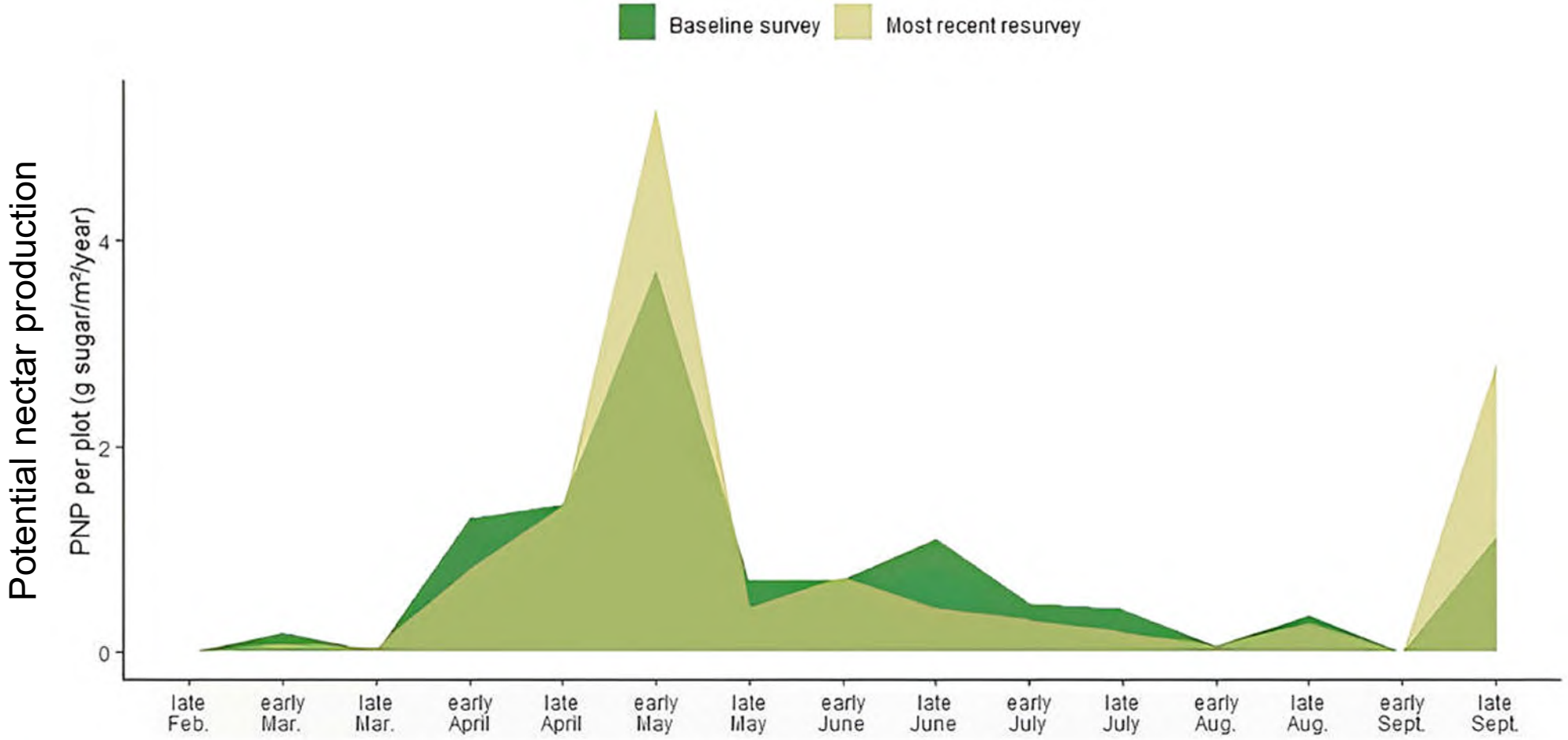
Zellweger et al. (2020) *Science*

MAIN FINDINGS: POLLINATORS

– Potential nectar production declined by 24%



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De Schuyter et al. (2024) *J. Ecol.*

POTENTIAL IMPLICATIONS FOR POLLINATORS

+ Canopy opening (light)
+ Litter quality
+/- more flowering?
- Potential nectar production
- Phylogenetic diversity

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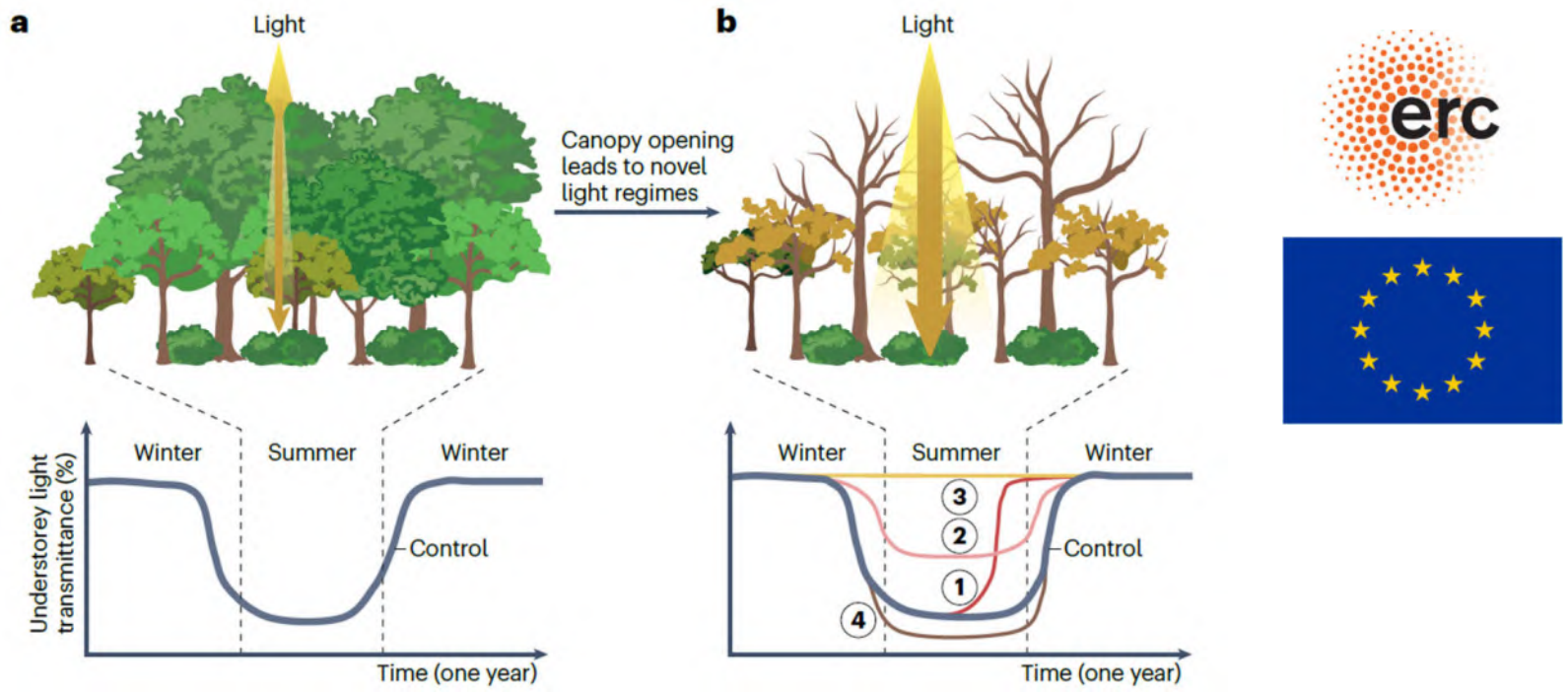
THE WAY FORWARD

- Fill regional gaps
- Forest disturbances & novel light regimes



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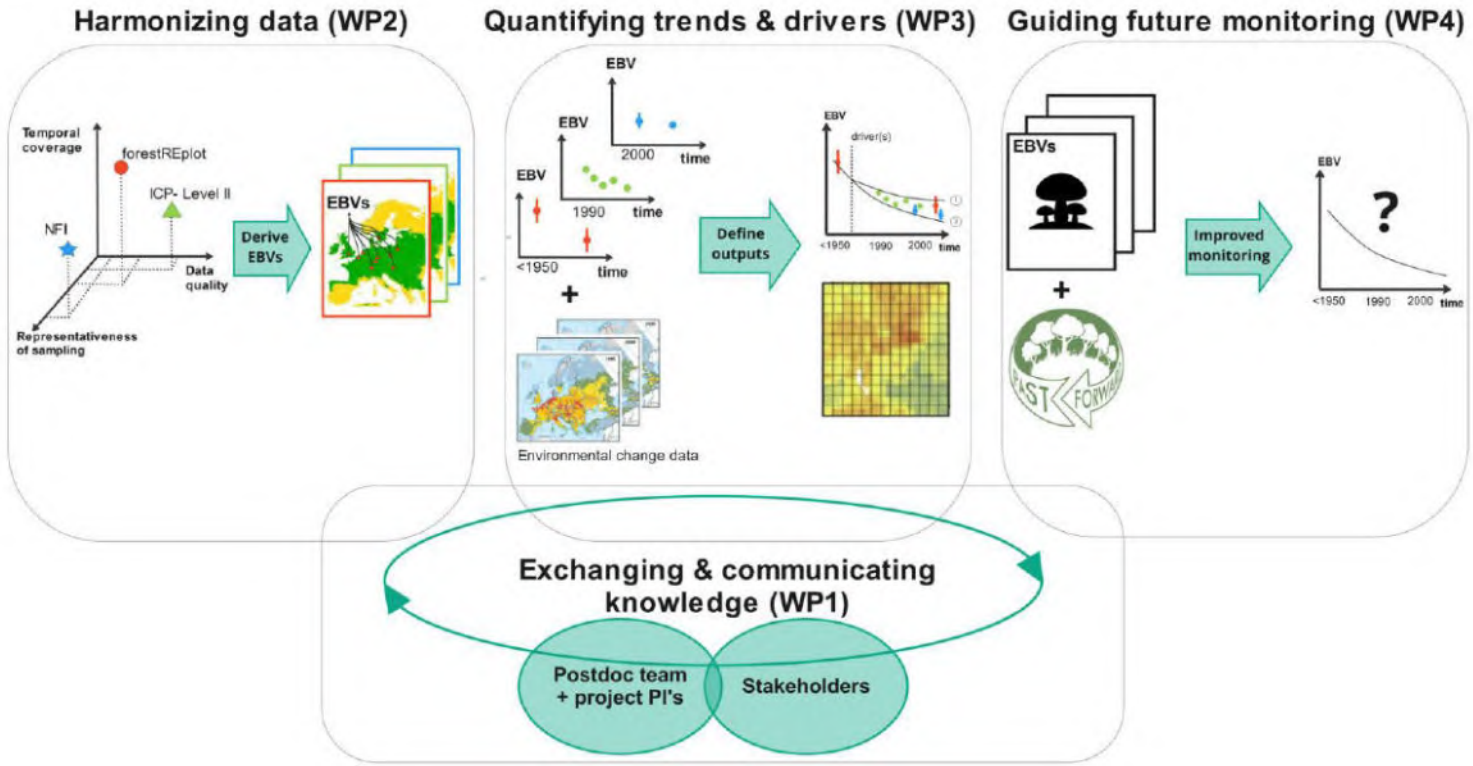
De Frenne (2024) *Nature Ecol. Evol.*

THE WAY FORWARD

- Fill regional gaps
- Forest disturbances & novel light regimes
- Inform policy → essential biodiversity variables



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THANK YOU!

Kris Verheyen; Lander Baeten; Martin Hermy; Hans Van Calster; Jörg Brunet; Ove Eriksson; Monika Wulf; Radim Hédl; Keith Kirby; Thomas Becker; Petr Petrik; Gian-Reto Walther; Guillaume Decocq; Patrick Hommel; George Peterken; Markus Bernhardt-Römermann; Miles Newman; Fraser Mitchell; Wolfgang Schmidt; Thomas Dirnböck; Tibor Standovár; Thilo Heinken; Frantisek Malis; Martin Kopecký; Ondřej Vild; Markéta Chudomelová; Bogdan Jaroszewicz; Jonathan Lenoir; Balázs Teleki; Fride Høistad Schei; Tomasz Durak; Kamila Reczyńska; Krzysztof Świerkosz; Tobias Naaf; Martin Diekmann; dr. Thomas A. Nagel; Déborah Closset-Kopp; Remigiusz Pielech; Peter Horchler; Anna Orczewska; Jan Šebesta; Kamila Reczyńska, Krzysztof Świerkosz; Antoine Becker-Scarpitta; Koenraad Van Meerbeek; Michael Jenkins; Frank Gilliam; Donald M. Waller; Kerry Woods; Mark Vellend; Daijiang Li; Donald Waller

FACULTY OF
BIOSCIENCE ENGINEERING

Pieter De Frenne

Professor

FOREST & NATURE LAB

E Pieter.DeFrenne@ugent.be
T +32 9 264 90 36

fornalab
@PieterDeFrenne
@fornalab

www.fornalab.ugent.be

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