

Forest Herbaceous Vegetation: A Key to Long-Term Changes in Forest Biodiversity

Radim Hédli



European Research Council project
Long-term woodland dynamics in Central Europe:
from estimations to a realistic model (2012–2016)

www.longwood.cz

Institute of Botany of the ASCR, v. v. i.

Zámek 1, CZ - 252 43 Průhonice, Czech Republic

www.ibot.cas.cz

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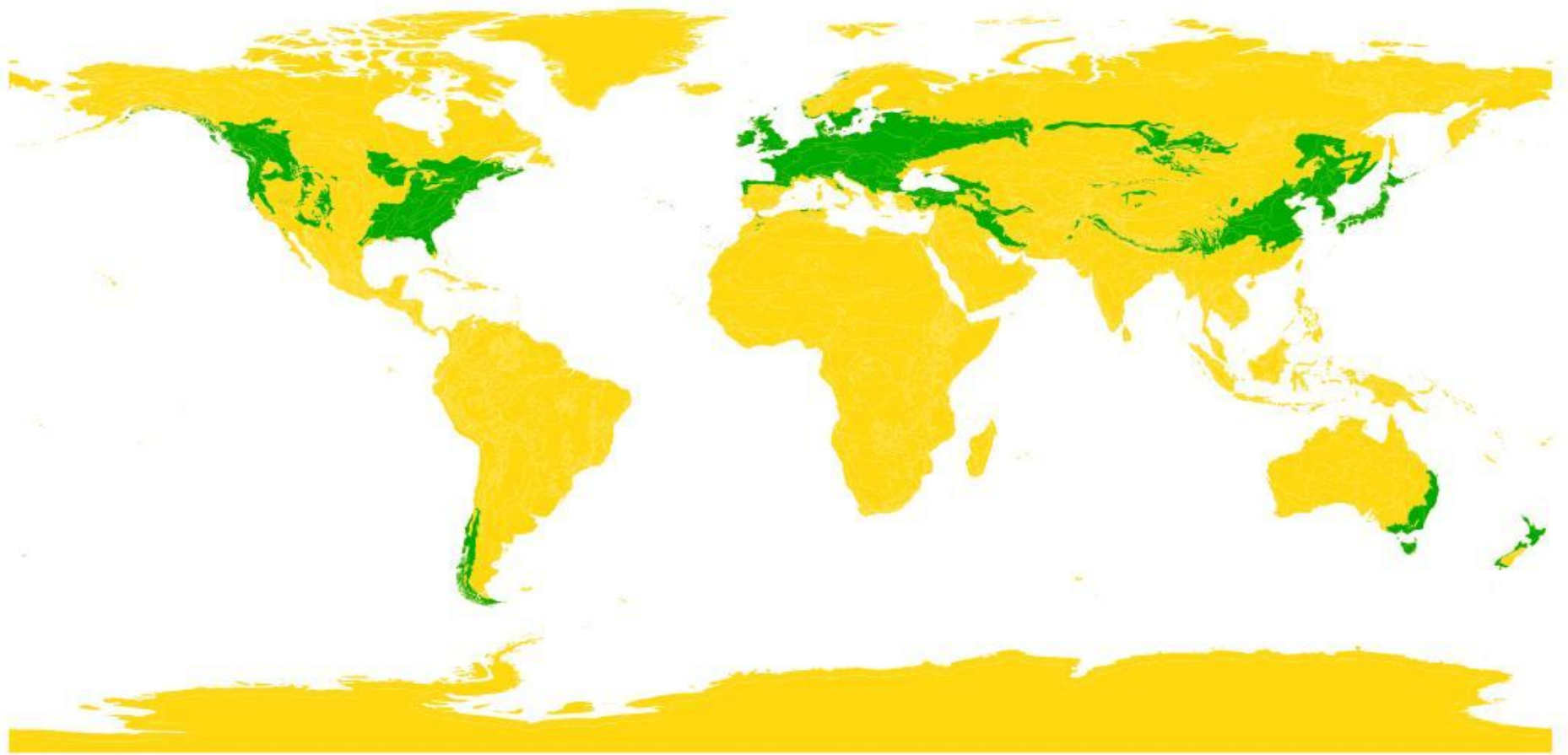
1. Herbaceous vegetation of the deciduous forests
2. How it is described, available data from the past
3. Major environmental changes in deciduous forests over the 20th c.
4. Consequences for biodiversity

Forest herbaceous vegetation

- all non-woody vascular plant species
- technically all vascular plants lower than 1-1.3 m
- present in boreal, **temperate** and tropical forests

1. Plant community **diversity concentrates** here.
2. Impact on **regeneration** of woody species.
3. High rate of **nutrient cycling**.
4. Reflects **habitat history** (landscape and local levels).
5. Sensitive **indicator** of environmental changes.

Distribution of temperate forest ecoregions



Based on Olsen et al. (2001), BioScience

Bohemian Karst, C-Bohemia

Cardamine bulbifera dominating spring vegetation in a former coppice-with-standards

~ 5 woody species (oak, hornbeam, lime, service tree, maple)

~ up to 80 herbaceous species / per 200 m²





Dubrava, S-Moravia

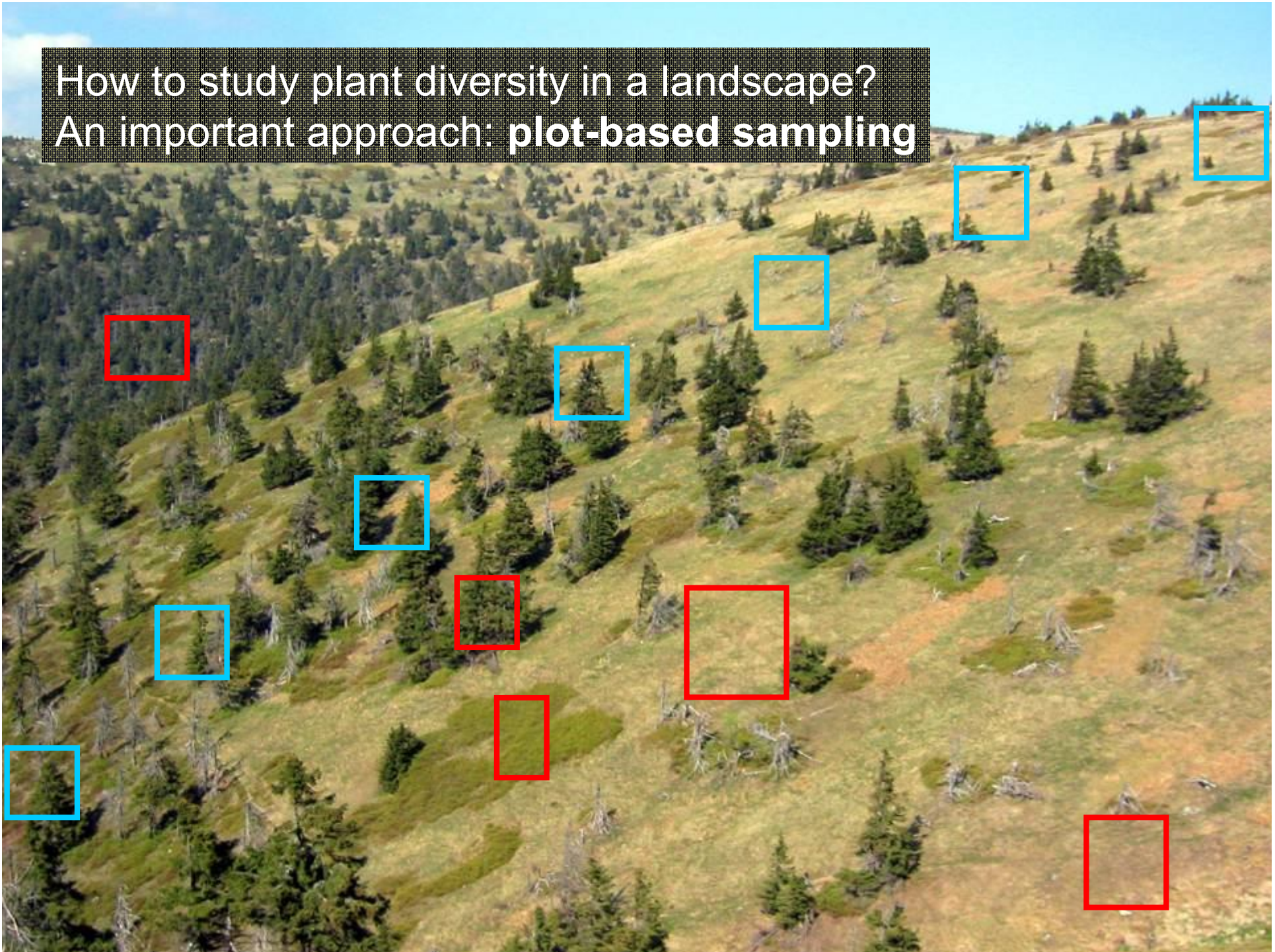
Forest sedges dominate understory of a former wood-pasture

~ mostly only oak (*Quercus robur*) in the tree layer

~ up to 100 herbaceous species / per 200 m²



How to study plant diversity in a landscape?
An important approach: **plot-based sampling**





Vegetation plots
(sometimes called relevés)

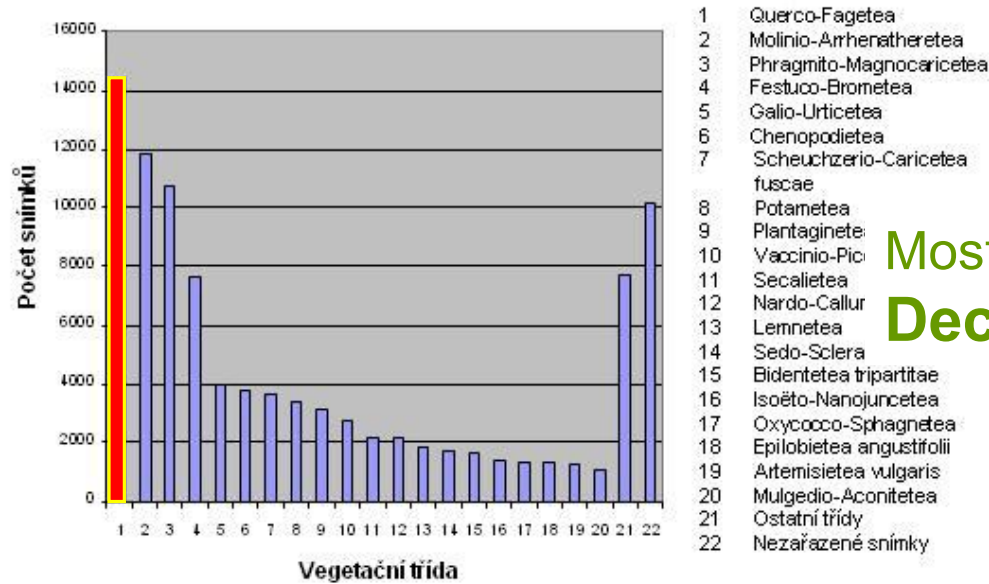
List of all plant species
with estimated abundances.

Global Index of Vegetation-Plot
Databases:
203 databases with 3,008,210
vegetation plots

Czech National Phytosociological Database

about 100 000 plots

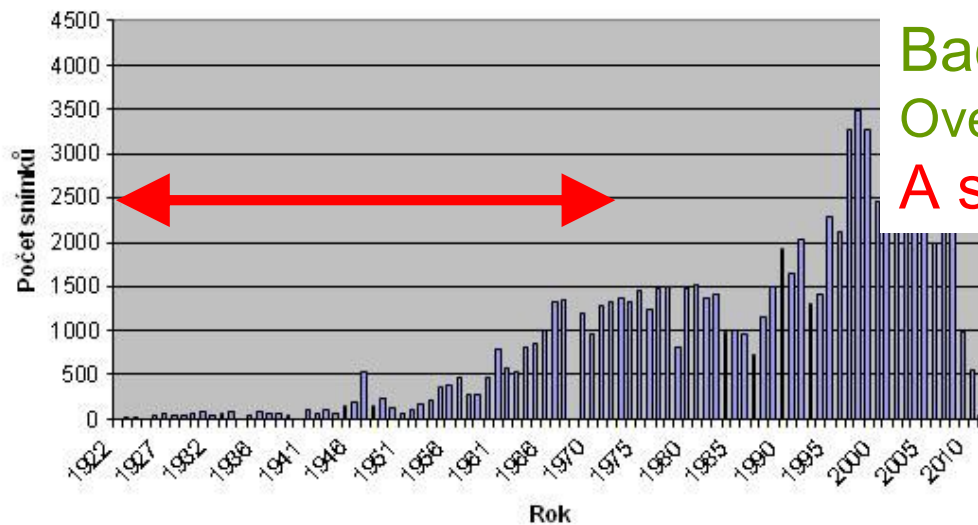
Počty snímků různých vegetačních tříd



- 1 Quercus-Fagetum
- 2 Molinio-Arrhenatheretea
- 3 Phragmito-Magnocaricetea
- 4 Festuco-Brometea
- 5 Galio-Urticetea
- 6 Chenopodietea
- 7 Scheuchzerio-Caricetea
- 8 Potametea
- 9 Plantaginetea
- 10 Vaccinio-Piceo
- 11 Secalietea
- 12 Nardo-Calluna
- 13 Lemnietea
- 14 Sedo-Sclerophylla
- 15 Bidentetea tripartitae
- 16 Isoëto-Nanojuncetea
- 17 Oxycocco-Sphagnetum
- 18 Epilobietea angustifolii
- 19 Artemisietea vulgaris
- 20 Mulgedio-Aconitetea
- 21 Ostatní třídy
- 22 Nezařazené snímky

Most frequently represented vegetation:
Deciduous forests

Počty snímků z různých let



Time span

Back to the 1920s

Over 20 thousand plots older than 40 yr

A source for historical research.

Indication of habitat conditions by plant species traits

Species indicator values

Soil nitrogen value: 6, 7, 5, 4, 5 > average: 5,4
median: 5



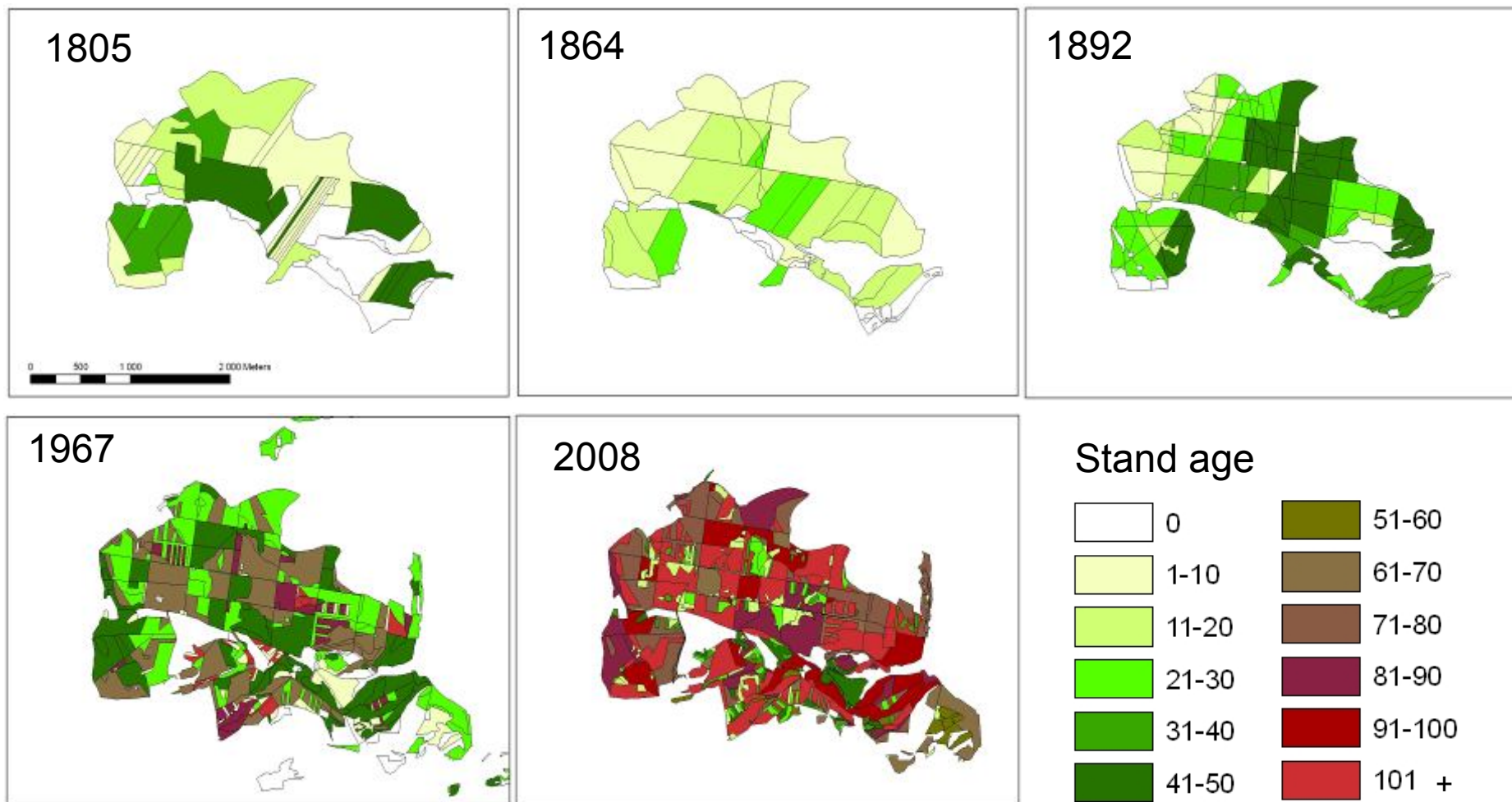
Four major drivers of changes in deciduous forests in the 20th century

1. Management changes
2. Atmospheric deposition
3. Ungulates (deer & co.)
4. Climatic changes



Increasing forest age in the past two centuries

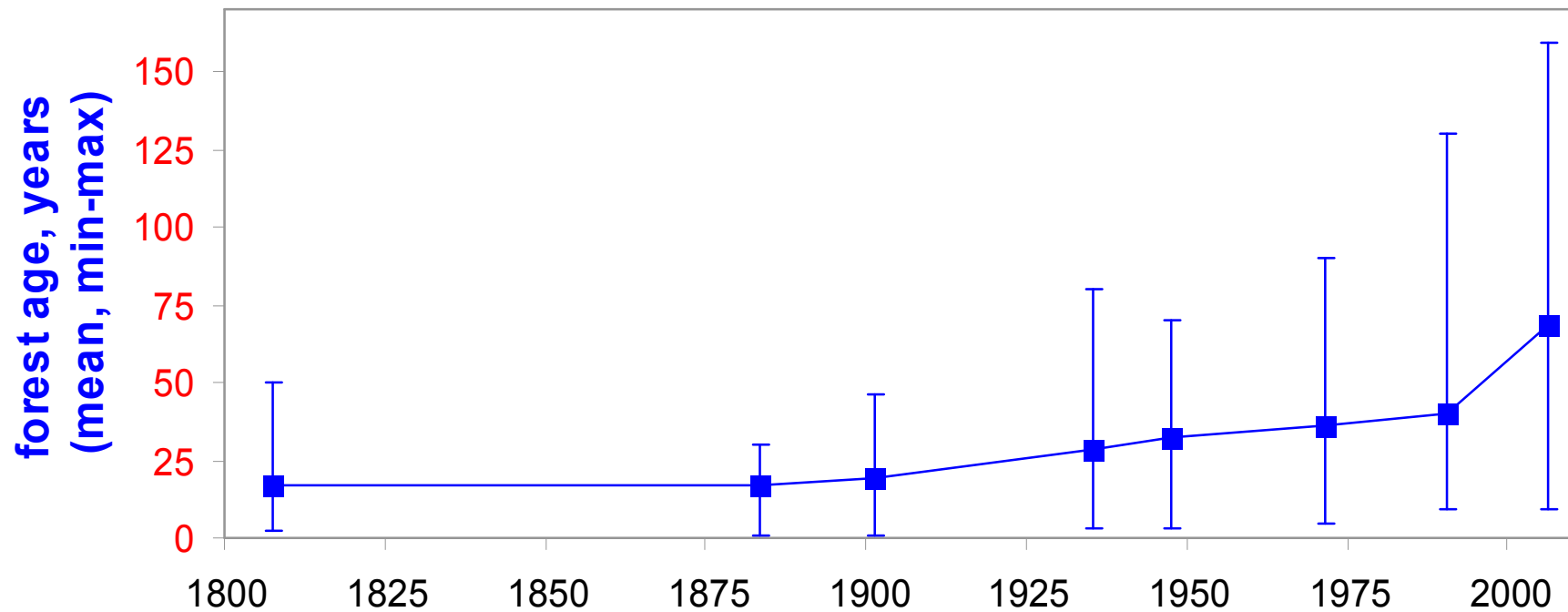
forestry maps, Koda, Bohemian Karst, ca. 400 ha



Orig. J. Müllerová

Forest stand age over the past 2 centuries

From forestry maps, Devin, S Moravia (~280 ha)



From Müllerová et al., 2014, under review

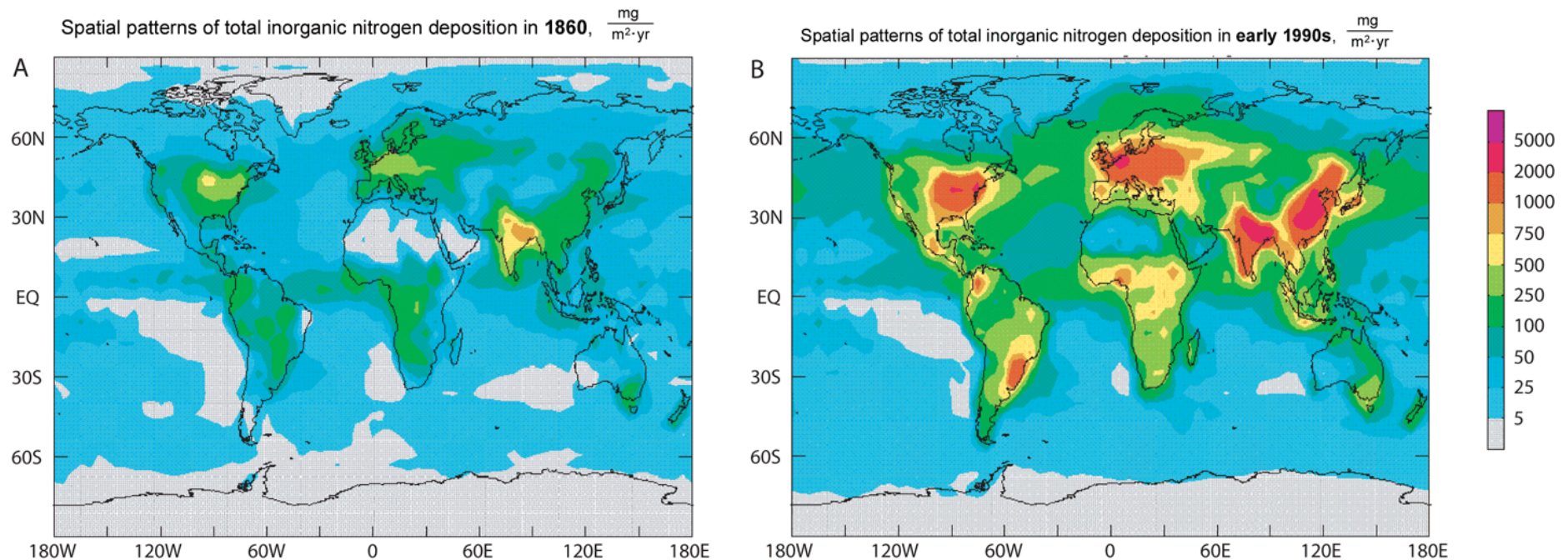
Atmospheric deposition of nitrogen

Combustion of fossil fuels, agriculture (ammonia)

In several regions, over 10 tons / ha / year

> Surplus of nitrogen (eutrophication)

> Acidification (NO_3^- > nitric acid)

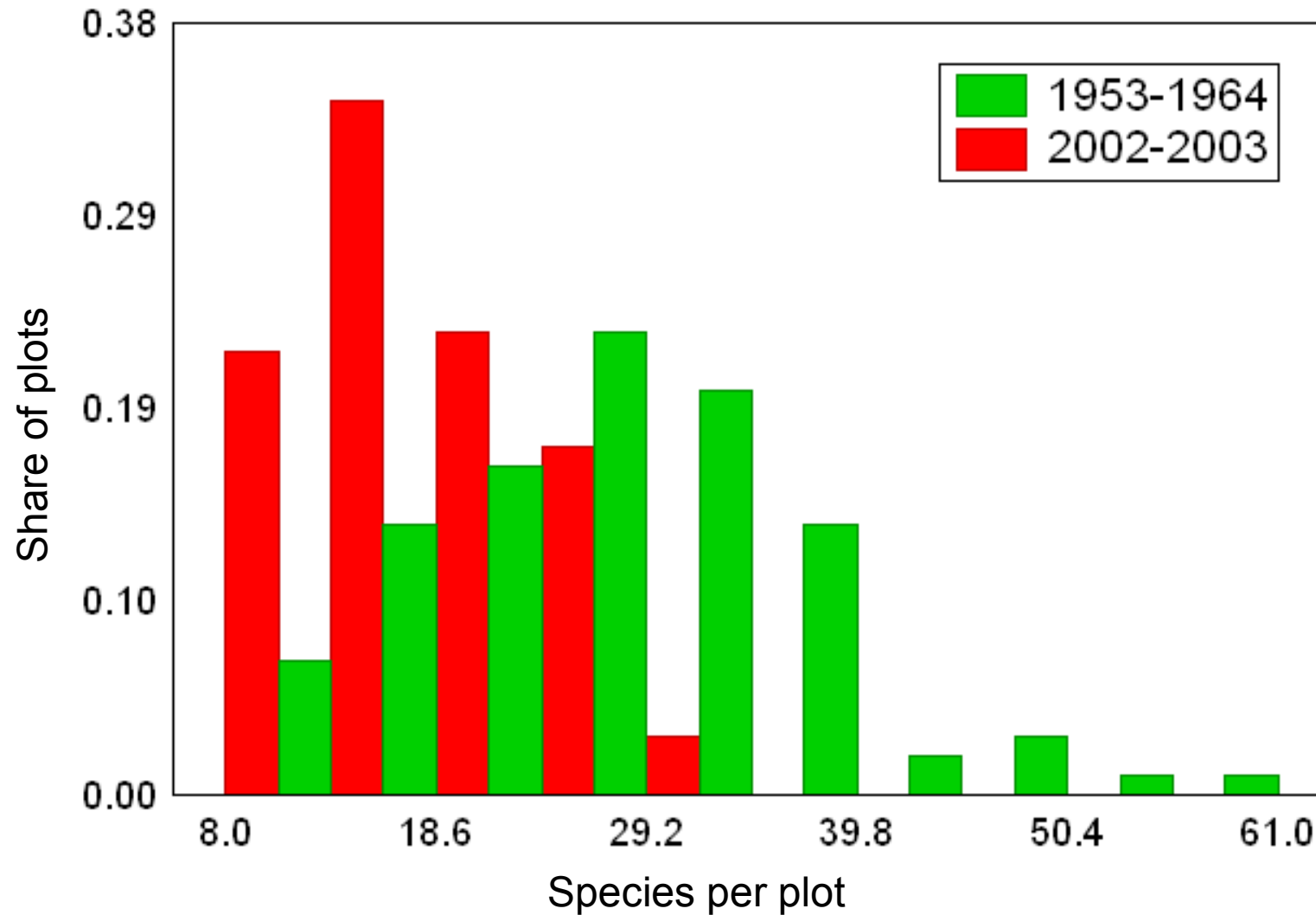


http://www.initrogen.net/itrogen_cycle_maps.0.html

Vegetation change in since the 1950s

Děvín, S Moravia; 180 resampled plots

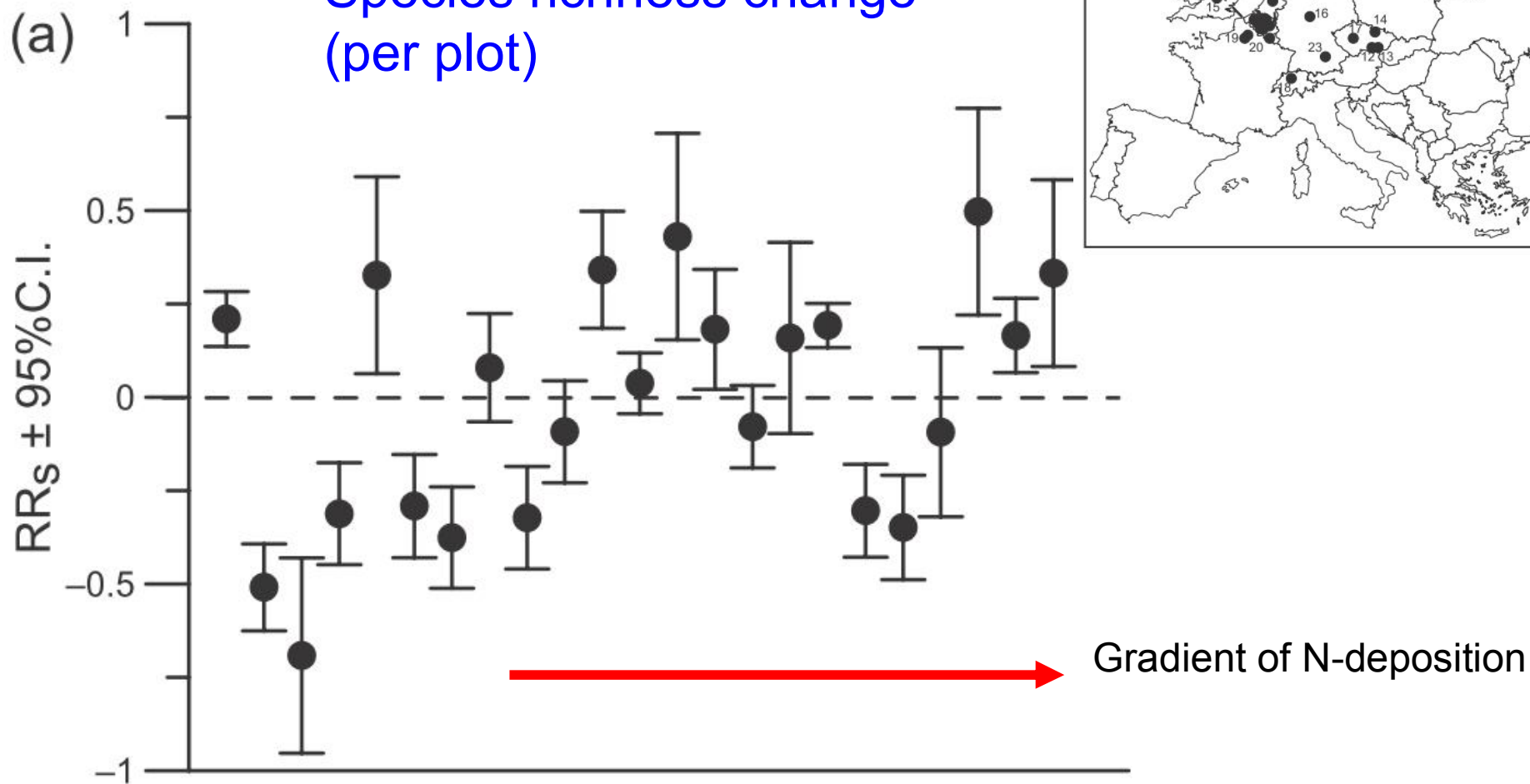
Species diversity impoverishment

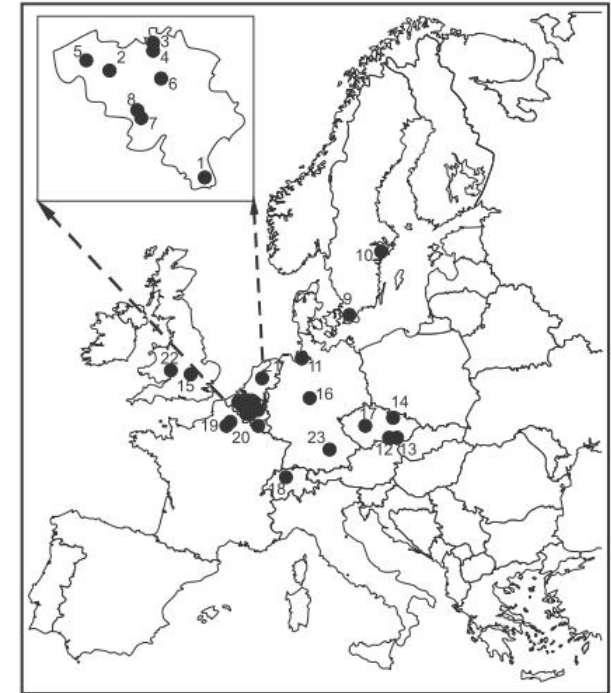
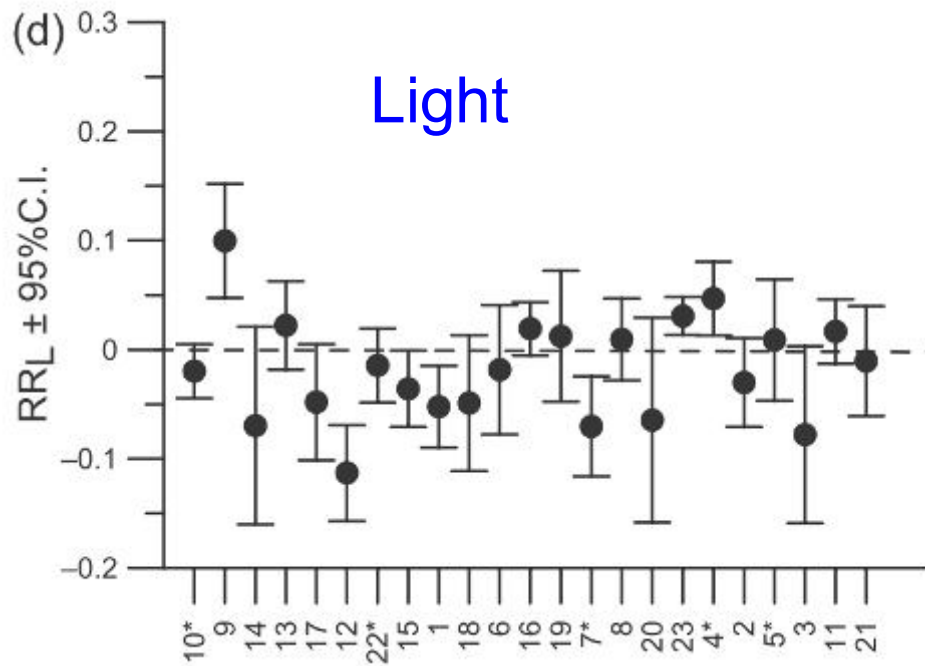
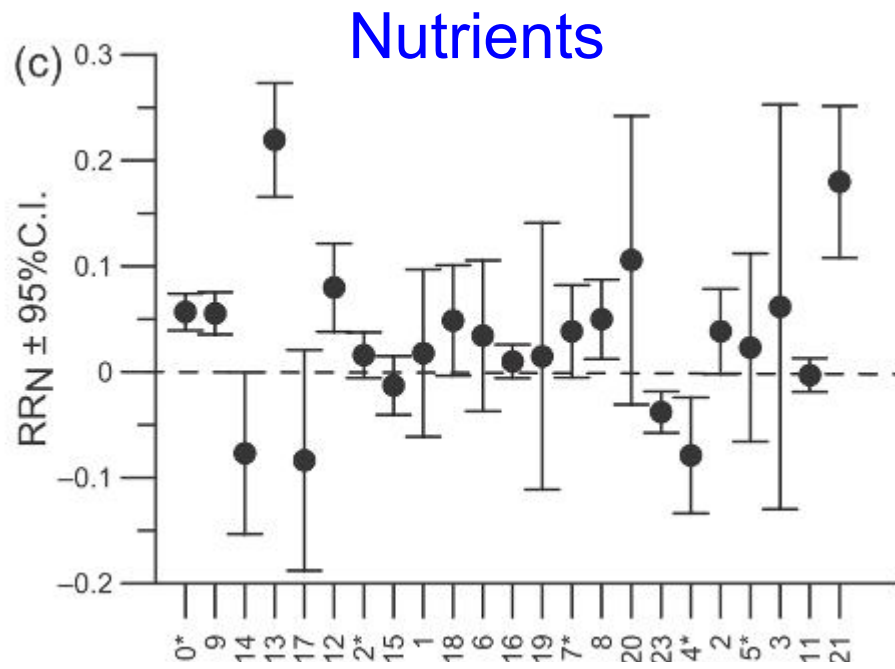


Species diversity changes in forests

23 resurvey studies from Europe

Species richness change
(per plot)





An alien to European forests:
Impatiens parviflora (of the Asian origin), an invading species since
about the 1950s and now well-established





Novel forest community to central Europe:
Chickweed-dominated oakwood

Chickweed (*Stellaria media*): nitrophilic weed, one of the most common plant species in the World

> **homogenization of biotic communities**

Detailed view to the chickweed-infested forest understory:
Stellaria media, *Galium aparine*, *Viola odorata*, *Chaerophyllum temulum*
All native, but replacing the original species assemblages



Where can vegetation ecology meet with paleoecology and historical ecology?

Recent and past analogues at various temporal scales

- interpretation of the past vegetation **composition** (spec. assemblages, veg. types)
- interpretation and explanation of the past species and vegetation **diversity**
- providing information on **environmental requirements** of species and veg. types
- interpretation of vegetation **dynamics** – succession, stability, rate of change
- background theory for the **natural potential** of habitats and vegetation
- search for the **origins** of the present vegetation types
- explanation of the past patterns by recent **management** analogues
- joint applications in nature's **conservation and management**

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The research leading to the presented results has received funding from the European Research Council under the European Union's Seventh Framework Programme (FP7/2007-2013) / ERC Grant agreement no 278065.



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