



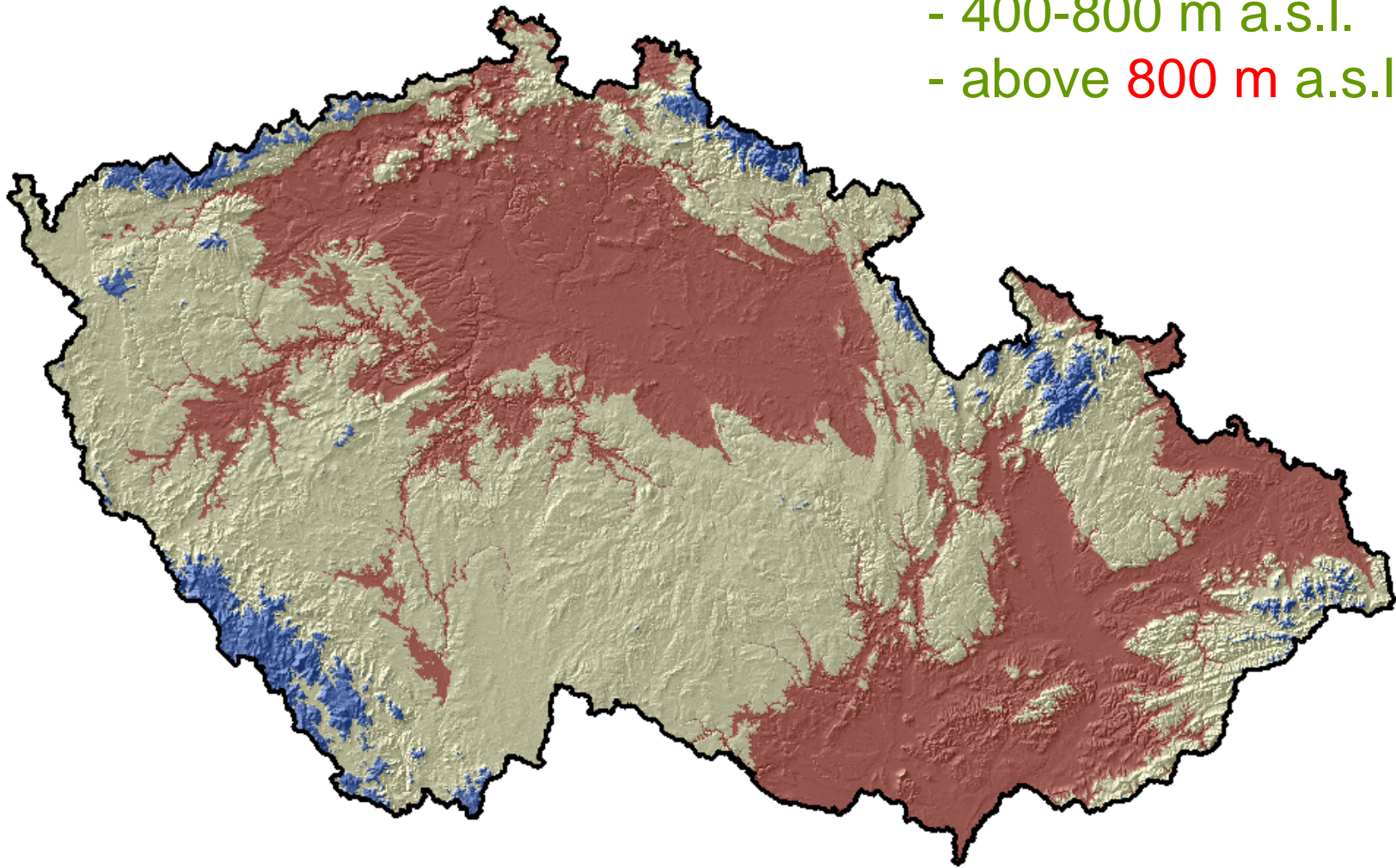
**Associations of lowland woodland in the
Czech Republic:
Is there an evidence for a long-term change from
thermophilous oakwoods to mesic forests?**

*R. Hédl, M. Kopecký,
M. Chudomelová, P. Halas, M. Macek,
M. Pospíšková, R. Prausová, O. Vild*

Institute of Botany of the ASCR, v. v. i.
Zámek 1, CZ - 252 43 Průhonice, Czech Republic
www.ibot.cas.cz

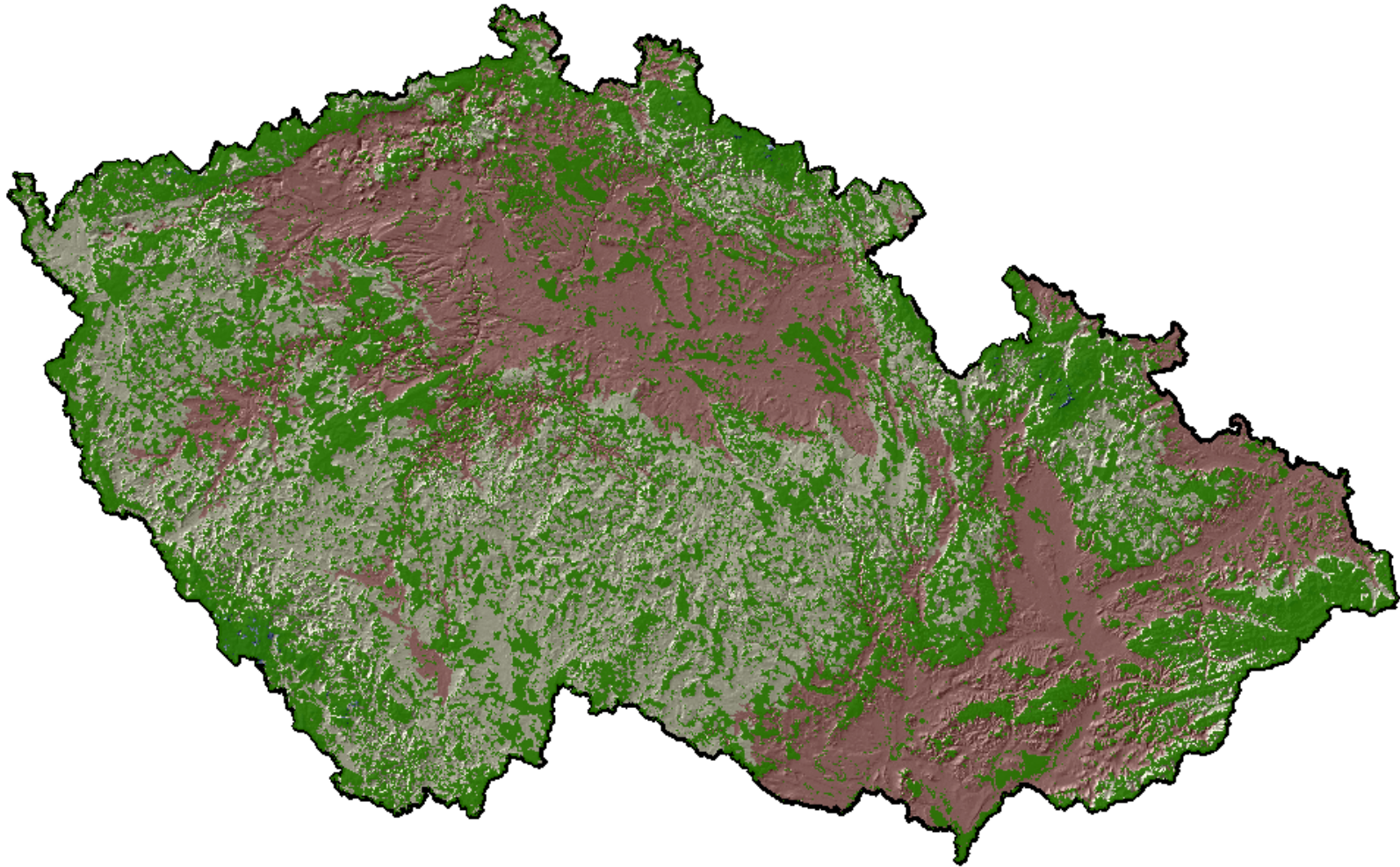
Main altitudinal zones of the Czech Republic

- lowlands - up to 400 m a.s.l.
- 400-800 m a.s.l.
- above 800 m a.s.l.



Forest covers 34% of the country

Lowland woodland (180-400 m a.s.l.)

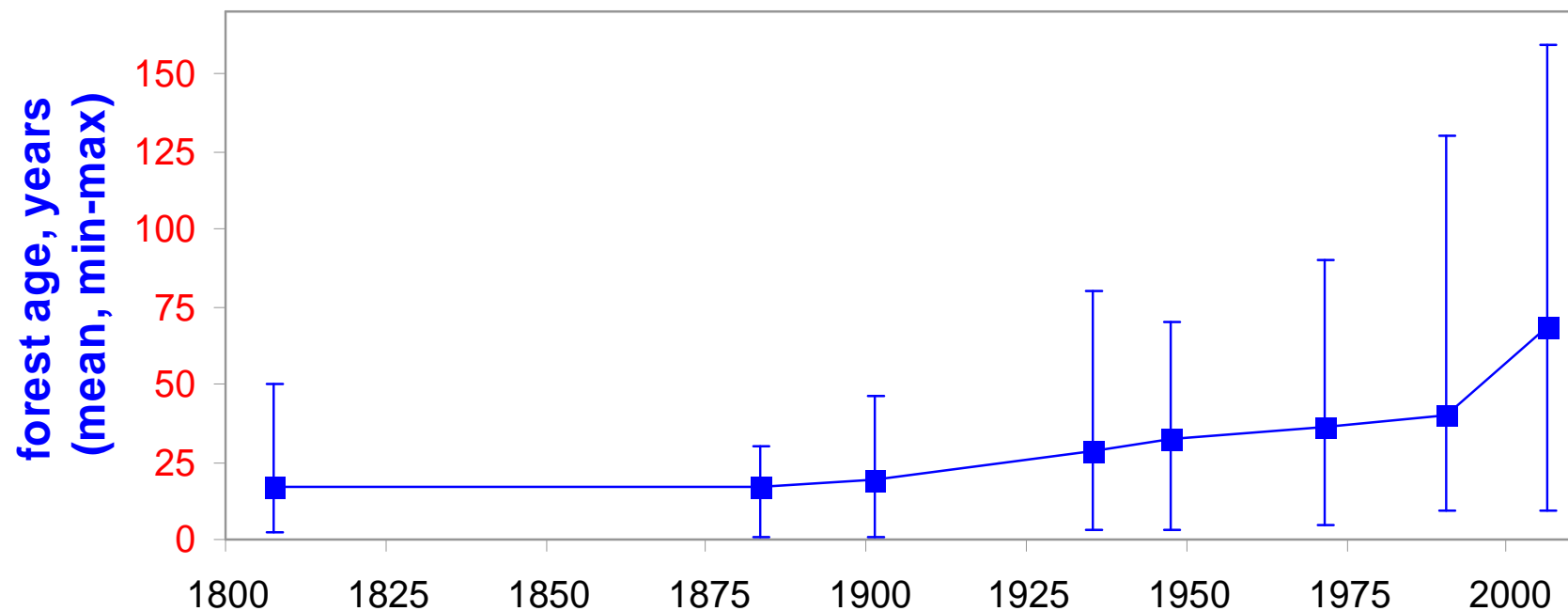


Long-term impacts

- decreased management intensity
- increased N-deposition
- increased game (deer) impact

Forest age over the past 2 centuries

Forestry management maps for Devín (~280 ha)



orig.: Jana Müllerová

Consequences

- environmental changes
- species composition: long-term change from **thermophilous oakwoods** to **mesic forests**

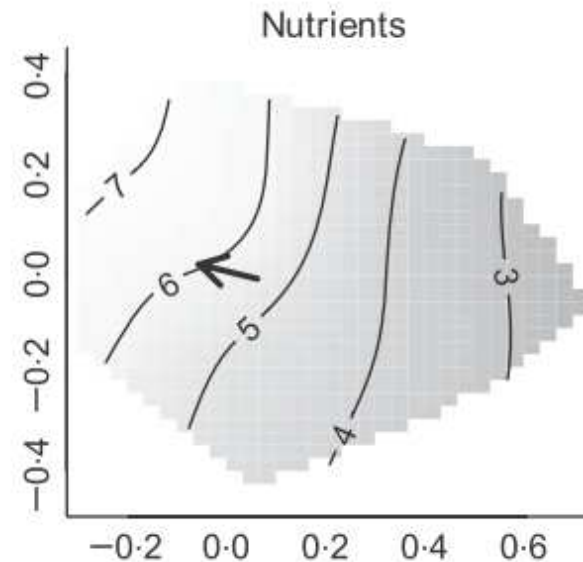
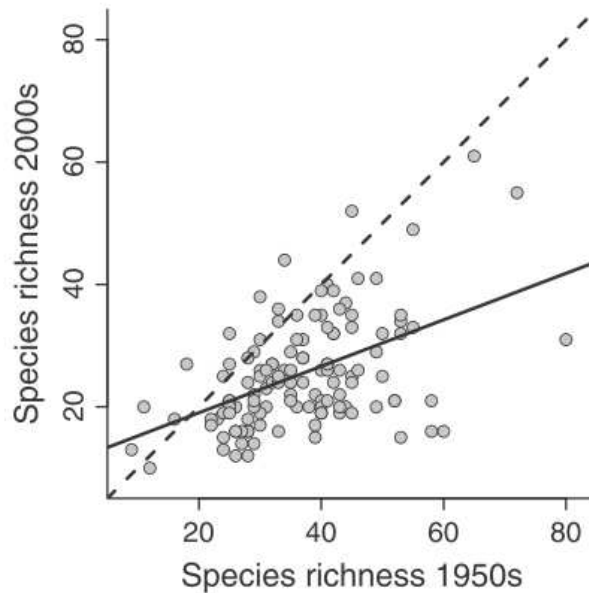
Documented on several published cases (CZ)

Chytrý & Danihelka 1993, Folia Geobotanica et Phytotaxonomica

Hédl, Kopecký & Komárek 2010, Diversity and Distributions

Kopecký, Hédl & Szabó 2013, Journal of Applied Ecology

- so far: quantitative evidence



Question:

- **Can we see such changes
at the level of phytosociological units?**

1	LBB01	Galio sylvatici-Carpinetum betuli
2	LBB02	Stellario holosteae-Carpinetum betuli
3	LBB03	Carici pilosae-Carpinetum betuli
4	LBB04	Primulo veris-Carpinetum betuli
5	LBC01	Galio odorati-Fagetum sylvaticae
6	LBC02	Mercuriali perennis-Fagetum sylvaticae
7	LBC03	Carici pilosae-Fagetum sylvaticae
8	LBF01	Aceri-Tilietum
9	LBF02	Mercuriali perennis-Fraxinetum excelsioris
10	LBF03	Arunco dioici-Aceretum pseudoplatani
11	LCA01	Lathyro collini-Quercetum pubescentis
12	LCA02	Lithospermo purpureocaerulei-Quercetum pubescentis
13	LCA03	Euphorbio-Quercetum
14	LCB01	Quercetum pubescenti-roboris
15	LCB02	Carici fritschii-Quercetum roboris
16	LCC01	Sorbo torminalis-Quercetum
17	LCC02	Genisto pilosae-Quercetum petraeae
18	LCC03	Melico pictae-Quercetum roboris
19	LDA01	Luzulo luzuloidis-Quercetum petraeae
20	LDA02	Viscario vulgaris-Quercetum petraeae
21	LDA03	Vaccinio vitis-idaeae-Quercetum roboris
22	LDA04	Holco mollis-Quercetum roboris

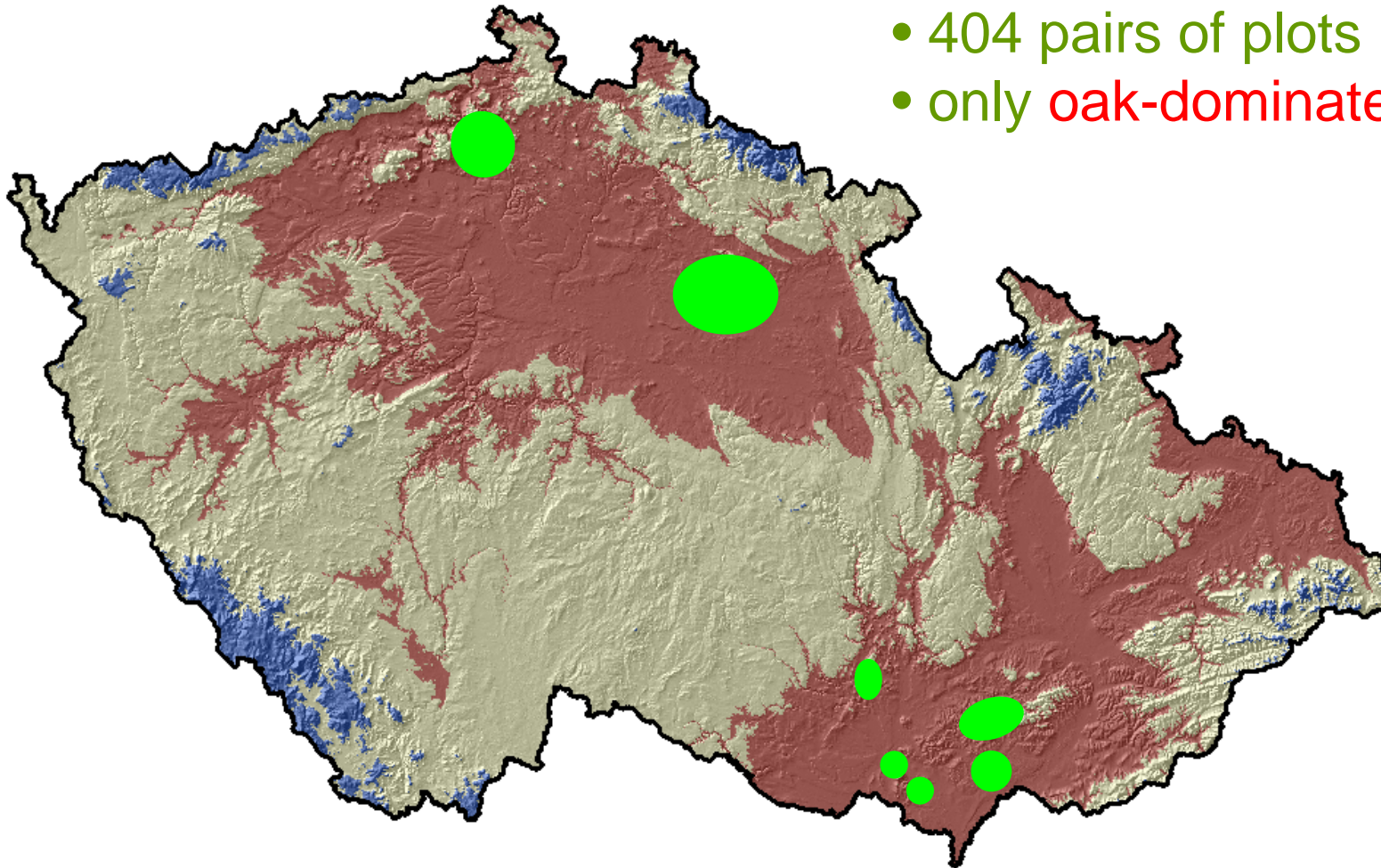
Carpino-Fagetea

Quercetea
pubescentis

Quercetea roboris-
petraeae

7 regions-sites with resurveys of forest vegetation

- 1950s-1960s, one source
- 2002-2012
- 404 pairs of plots
- only **oak-dominated**



Analysis

- the current **CZ phytosociological classification** (Chytrý & coll.)
- **3 approaches**: decreasing „severity“ of classification criteria

1. Expert system

Formalized formulas to classify vegetation plots into associations:

```
LBB01 Galio sylvatici-Carpinetum betuli
((((<Carpinus betulusUP50>OR<Quercus petraea agg.UP50>)OR<Quercus roburUP50>)OR(<Carpinus betulusUP25>
AND((<Quercus petraea agg.UP25>OR<Quercus roburUP25>)OR <Quercus speciesUP25>)))AND<### Lathyrus
vernus>)NOT((((((((((((((((<### Carex pilosa>OR<### Carex remota>)OR<### Geranium sanguineum>)OR<###
Lithospermum purpurocaeruleum>)OR<### Serratula tinctoria>)OR<### Urtica dioica>)OR<Abies albaUP25>)OR<Acer
platanoidesUP05>)OR<Acer pseudoplatanusUP05>)OR<Carex pilosaUP25>)OR<Fagus sylvaticaUP25>)OR<Fraxinus
excelsiorUP25>)OR<Larix deciduaUP25>)OR<Picea abiesUP25>)OR<Pinus sylvestrisUP25>)OR<Ulmus
glabraUP05>)OR<Tilia cordataUP25>)OR<Tilia platyphyllosUP05>)
```

2. Assignment by Frequency-Positive Fidelity Index (FPFI)

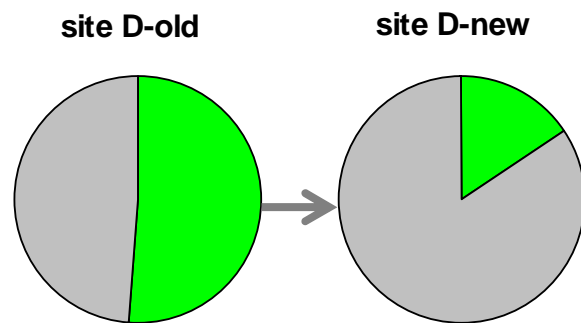
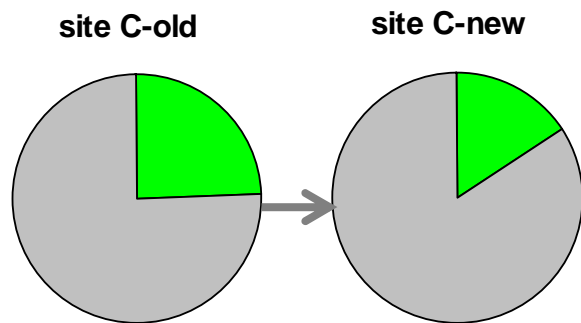
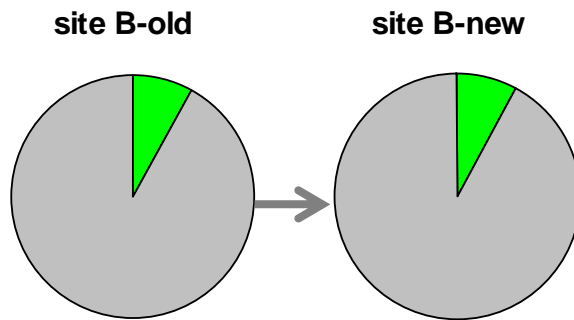
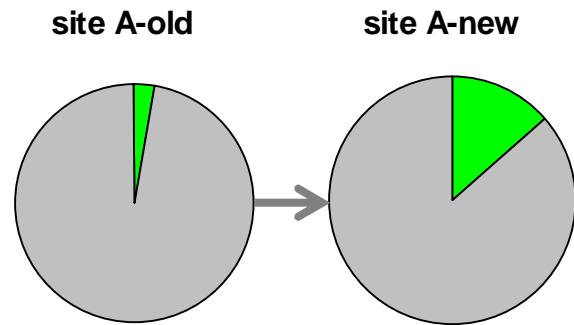
Similarity of vegetation plots to groups of classified relevés:

Number of relevés:			155	67	0	Max.	Qual.
Relevés	9393						
Species	1149		21	22	23		
	795	178153	22	13.5	9.5	---	21
	2472	249291	22	15.5	14.8	---	21
	1549	199804	22	20.5	20.3	---	19
							5.7
							8.7
							11.3

3. Frequency of diagnostic species

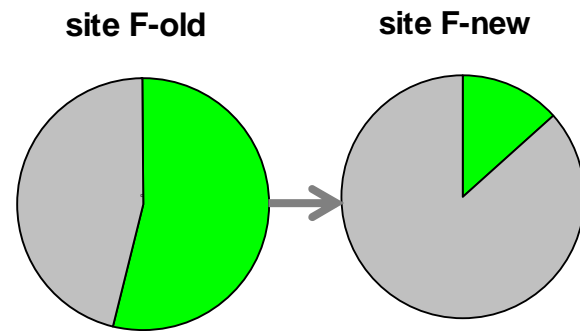
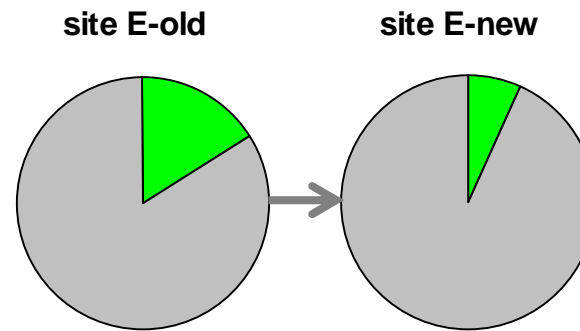
Species concentrated in certain associations (but can occur elsewhere).

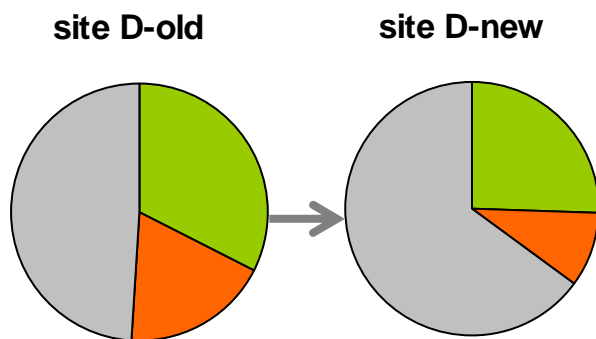
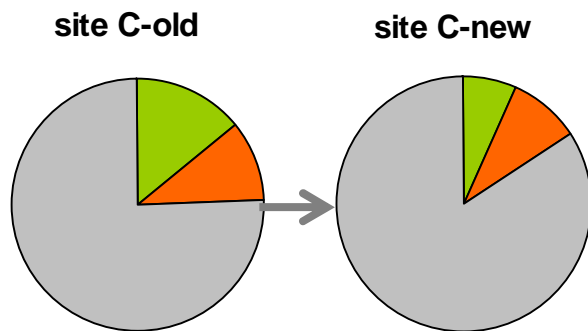
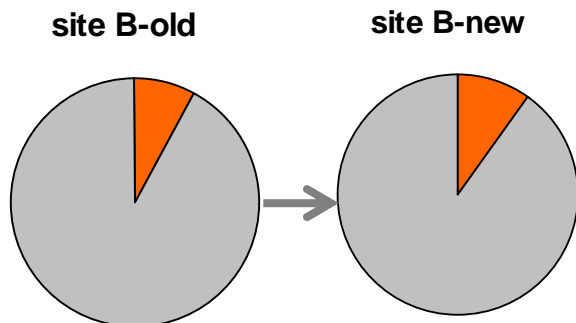
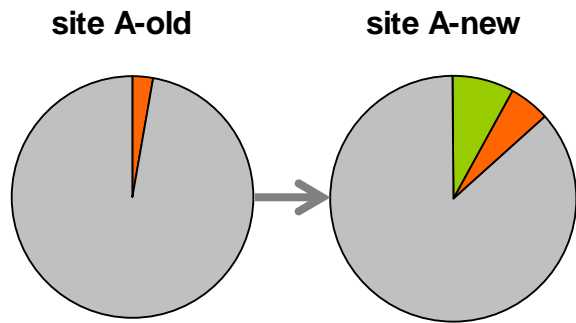
Diagnostic species: *Carpinus betulus*, *Quercus petraea* agg.; *Convallaria majalis*, *Festuca heterophylla*, *Galium sylvaticum*, *Hepatica nobilis*, *Lathyrus niger*, *Lathyrus vernus*, *Melica nutans*, *Poa nemoralis*, *Stellaria holostea*, *Tanacetum corymbosum*



1. Expert system

% of plots classified to an association



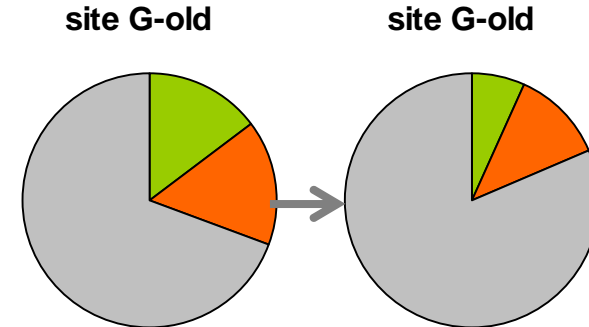
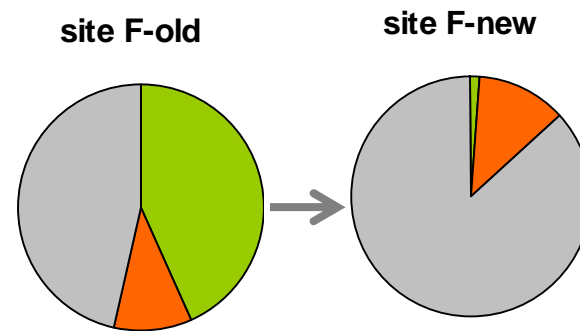


1. Expert system

% of plots classified to one association

Galio odorati-Carpinetum betuli

(other associations)



1. Expert system

plots classified to associations:

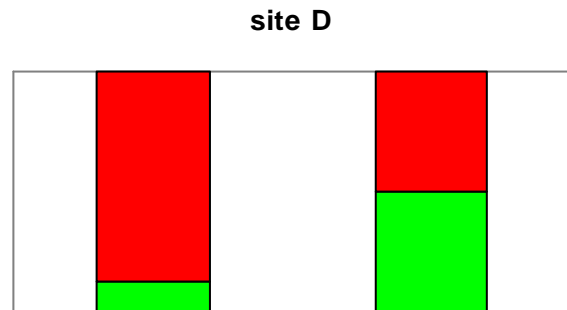
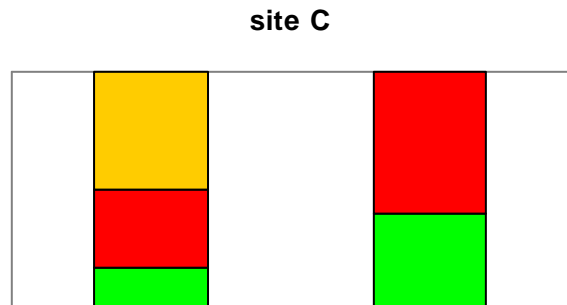
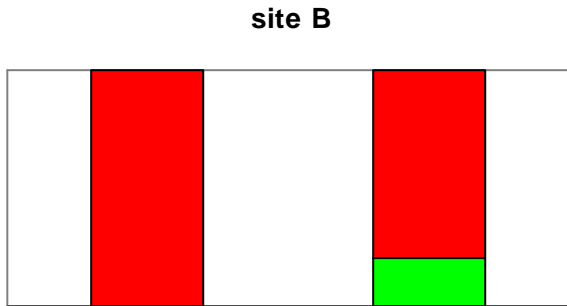
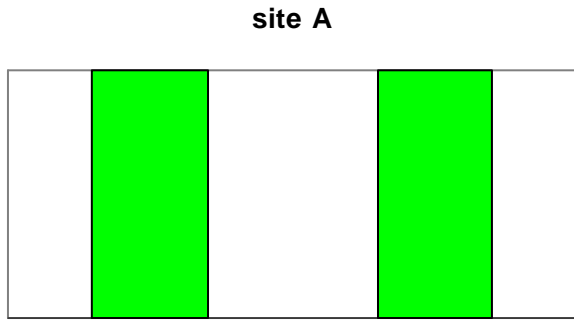
mesic forests (LB, without LBB01)

thermophilous oakwoods (LC)

acidophilous oakwoods (LD)

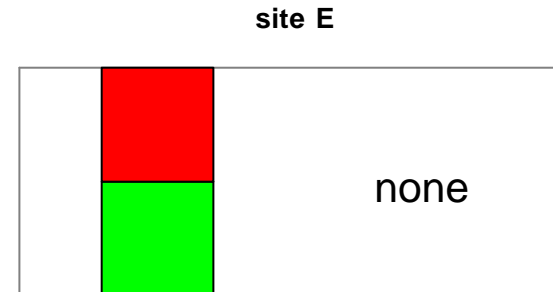
Note: bars represent proportions, not numbers of plots

* $\frac{1}{4}$ or more plots classified



old

new



old

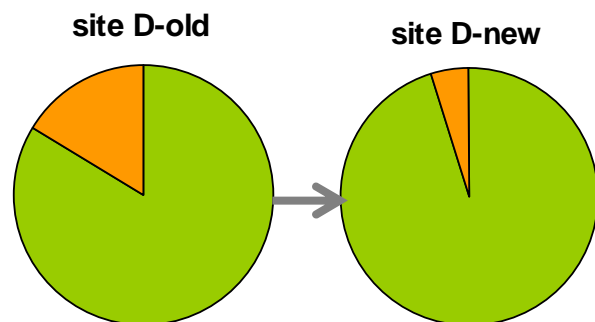
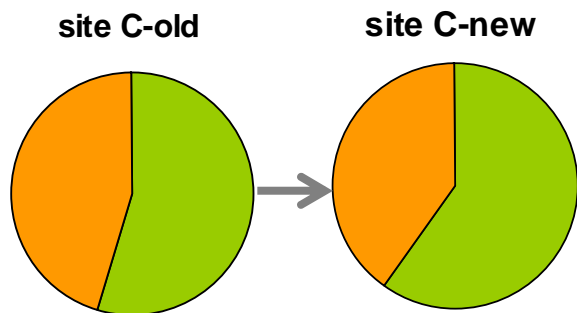
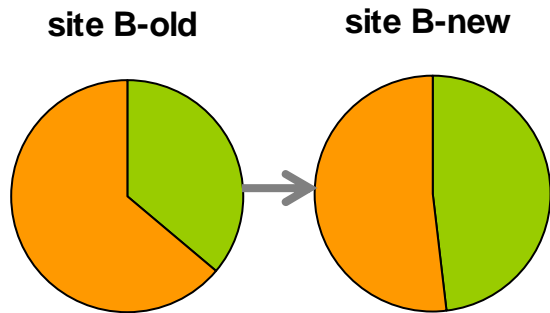
new

*

*

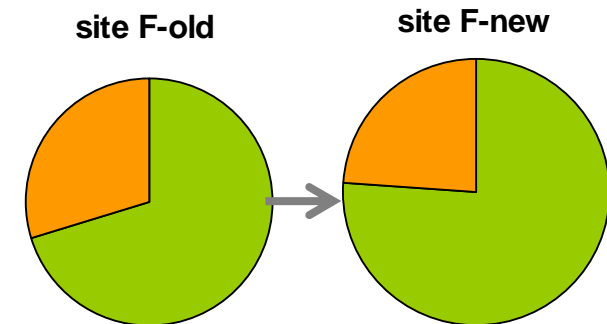
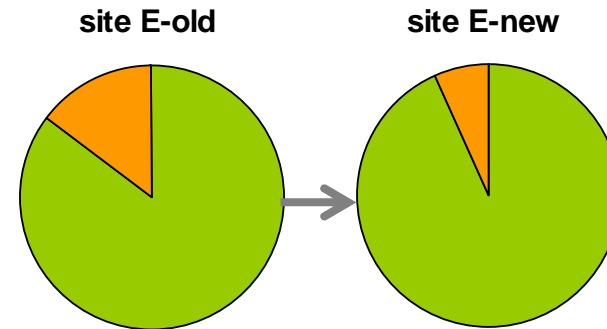
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2. FPMI index

% of plots assigned to one association:
Galio odorati-Carpinetum betuli
 (other associations)



Note: by FPMI, all plots are being assigned

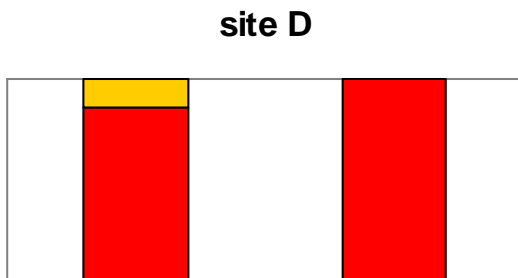
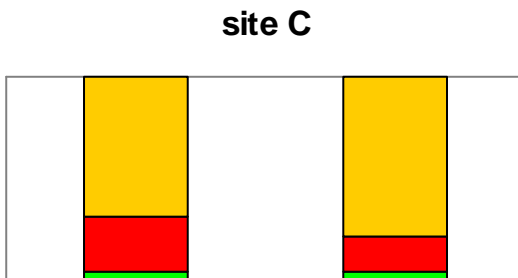
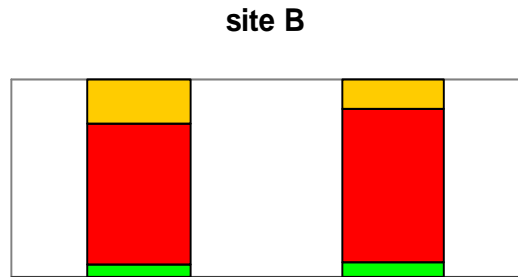
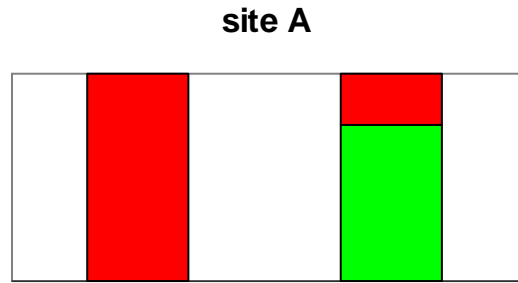
2. FPMI index

plots assigned to associations:

mesic forests (LB, without LBB01)

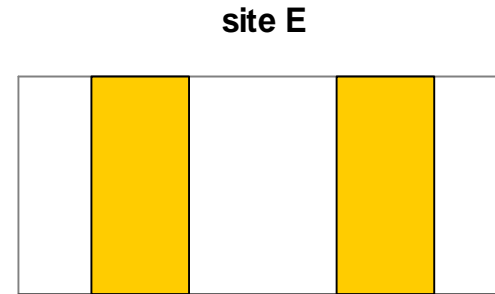
thermophilous oakwoods (LC)

acidophilous oakwoods (LD)



old

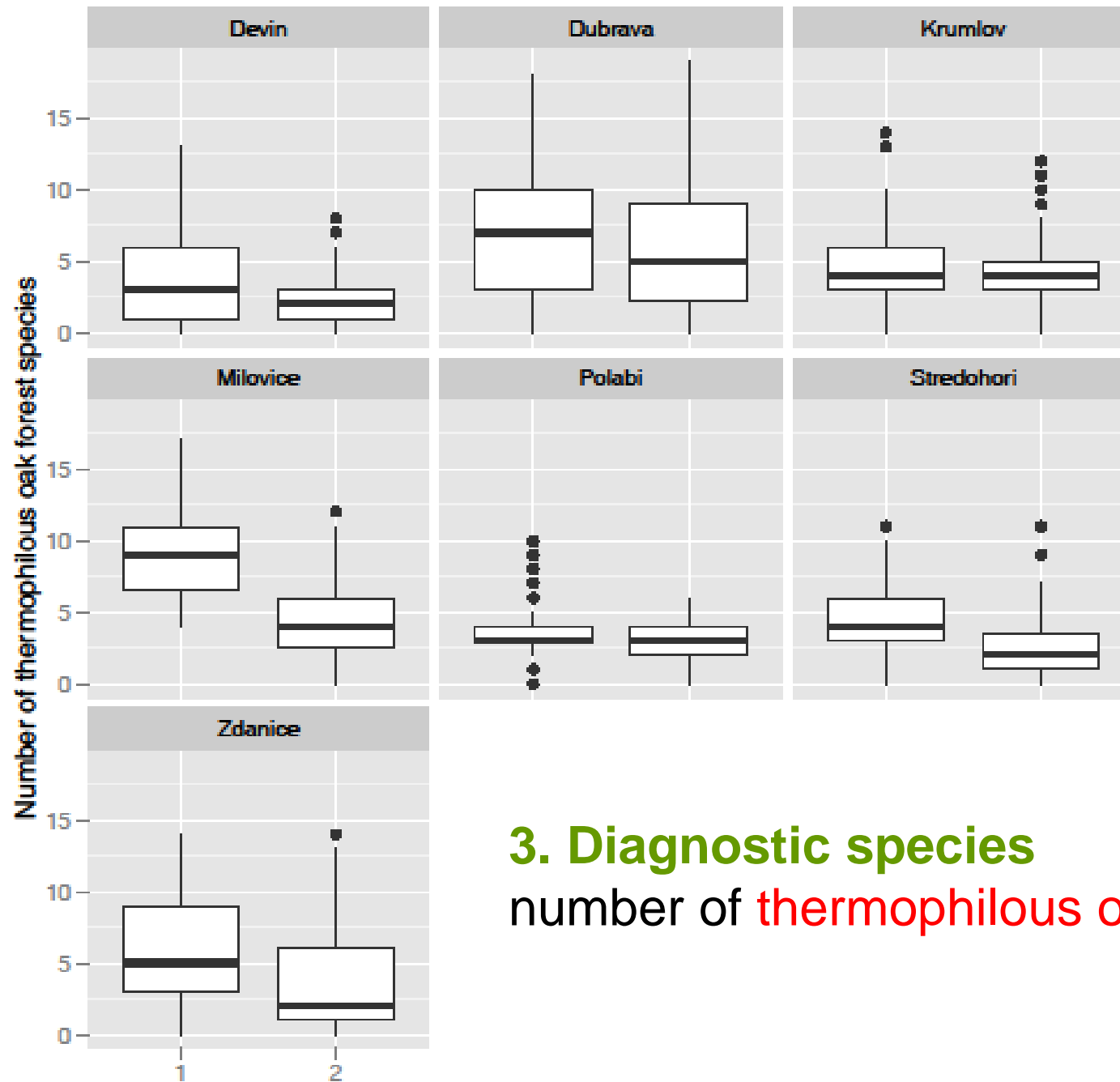
new



old

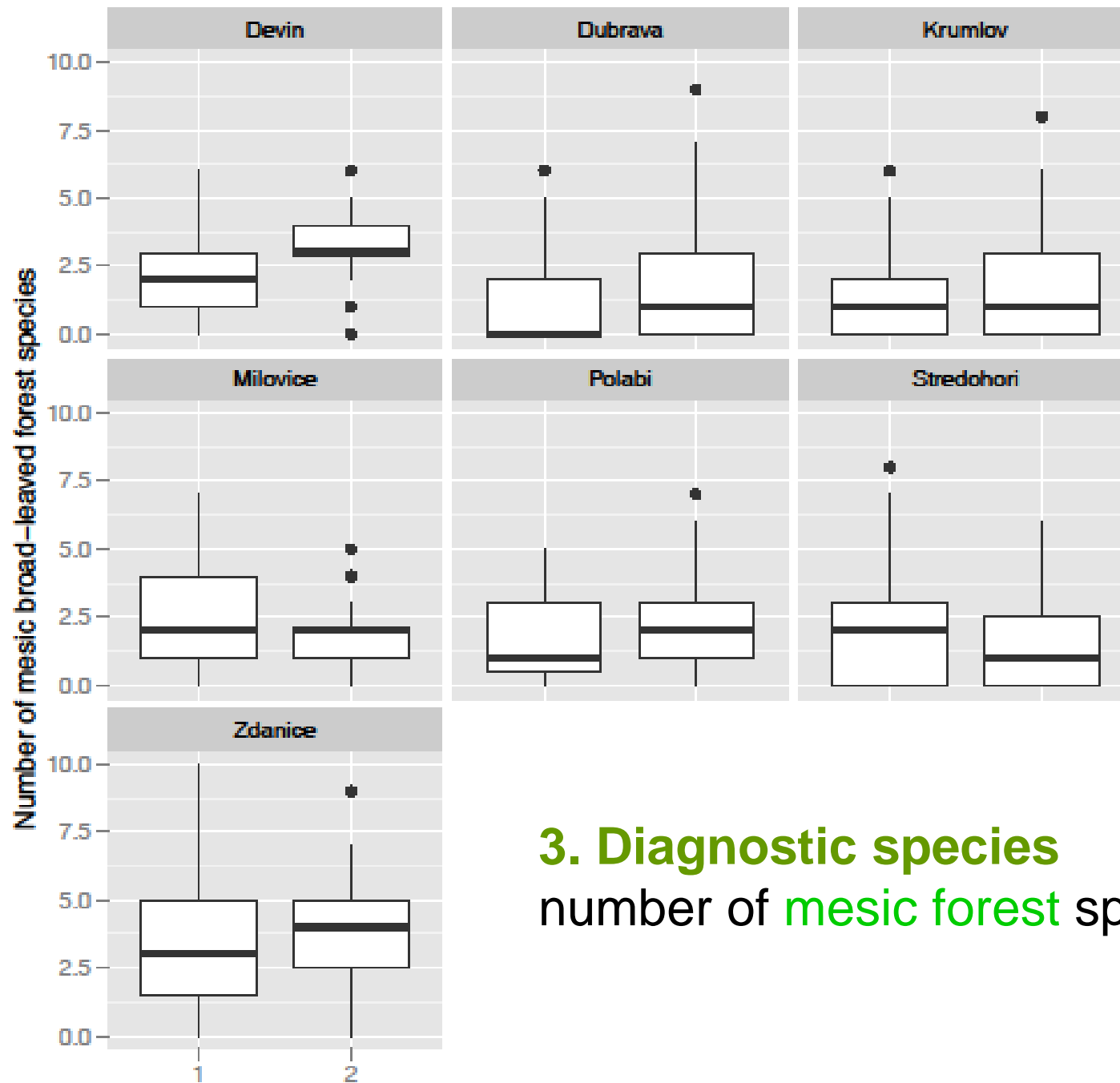
new

Note: bars represent proportions, not numbers of plots



3. Diagnostic species

number of thermophilous oakwood spp.



3. Diagnostic species
 number of mesic forest spp.

So what?

- regions differ in their vegetation
- methods differ in their results
- scientists differ in their opinions

But the change from the thermophilous oakwoods to mesic forests **can be observed even at the level of phytosociological units**

... ~5 of 7 surveyed sites say so