Spatial patterns of Tree-related Microhabitats: key factors and ecological significance for the conservation of the associated biodiversity

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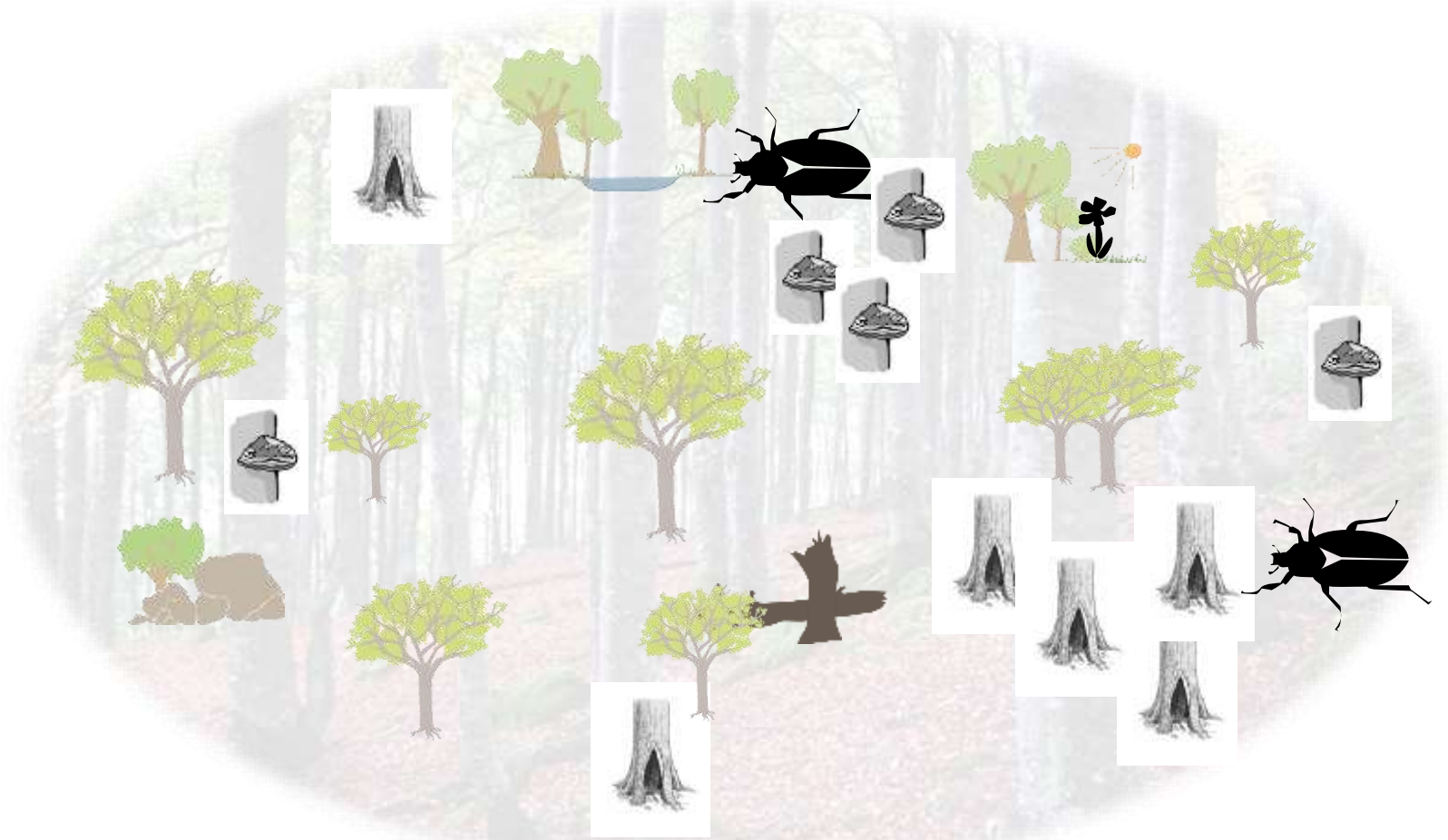


5th European Congress of Conservation Biology, Jyvaskyla, Finland, 12-15th June 2018

A Tree-related Microhabitat (TreM) is a specific above-ground tree morphological singularity (Larrieu, Paillet, Winter et al. 2017)

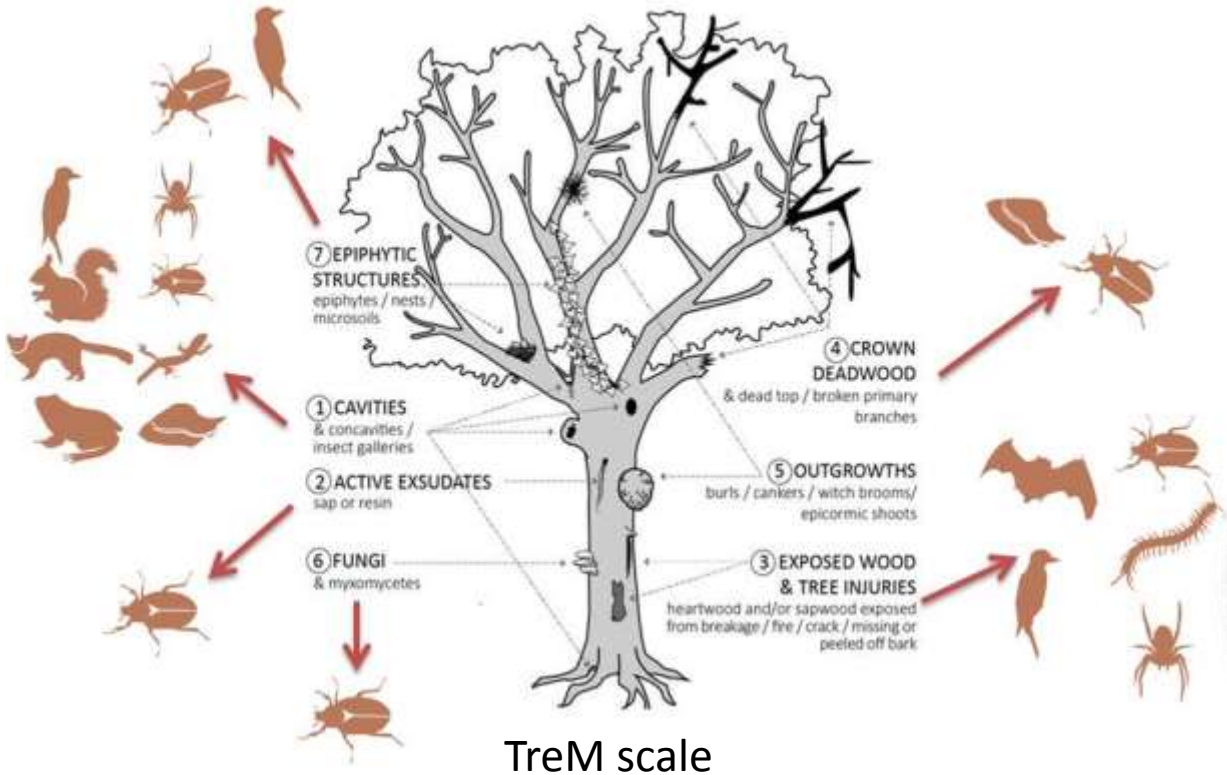
- distinct, **well delineated structure**
- borne by **standing living** or **dead trees**
- **essential substrate or life-site for taxa**
- encompassing decaying wood (=saproxylic TreM) or not (=epixylic TreM)

Cavities *Injuries* *Crown deadwood* *Excrescences* *Fungi* *Epiphytes* *Exudates*

7 Forms

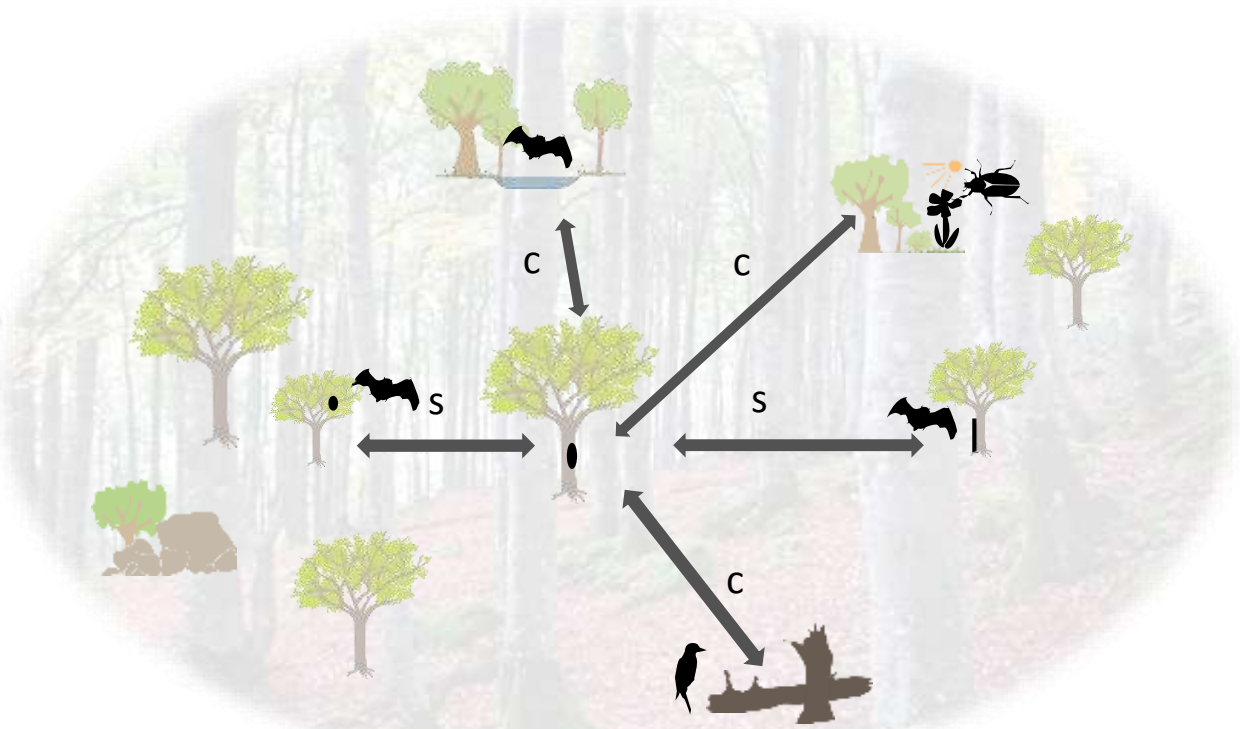
Drawings L. Apfelbacher

TReMs are key features for many taxa and participate in a complex functional habitat network in species life cycles



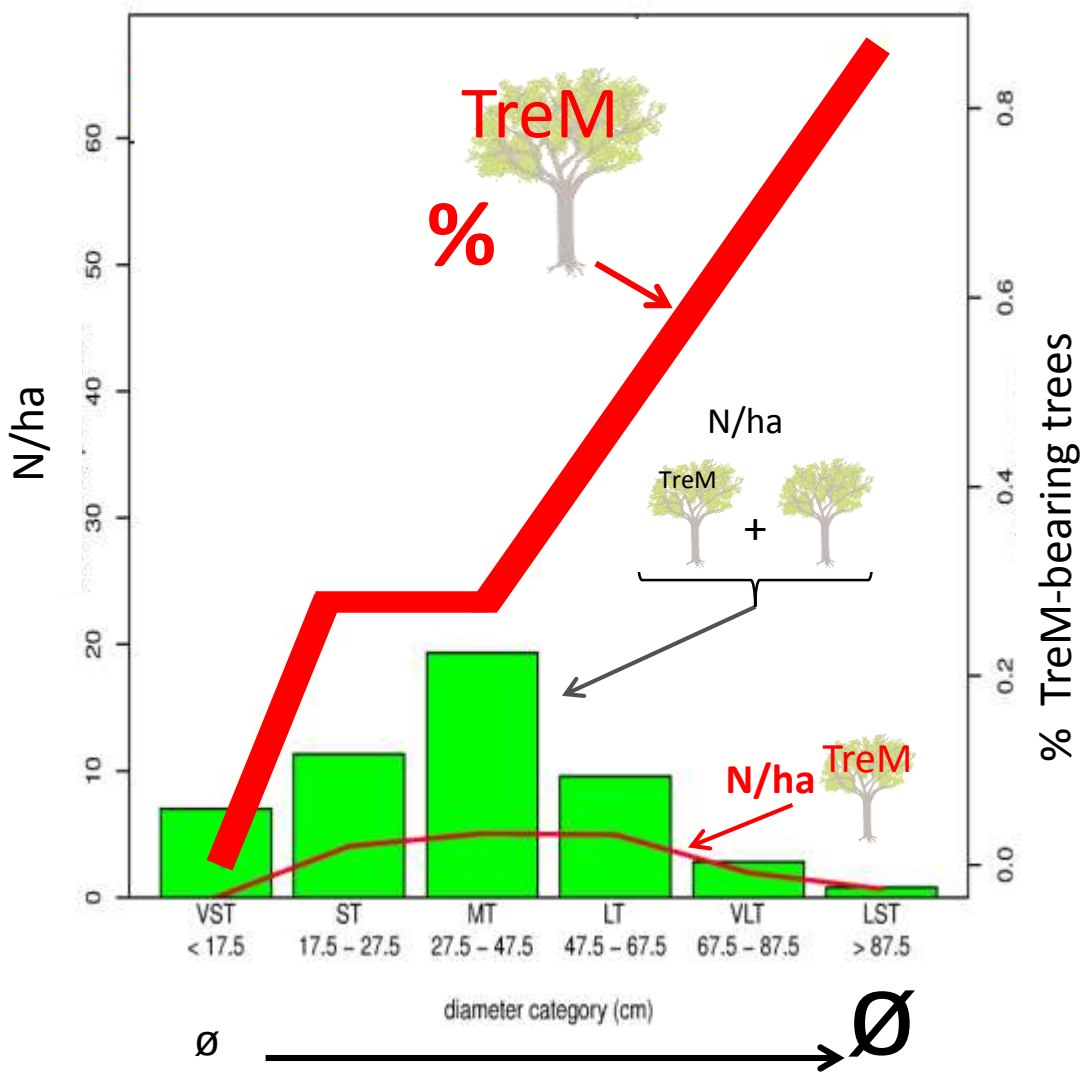
TreM scale

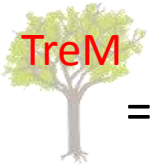
Stand scale



Examples of supplementation (s) and complementation (c) resources

Large trees bear most of the TreMs within a forest stand (e.g. Larrieu et al. EJFR 2012)





= TreM-bearing trees

(See also: Michel et al. CJFR 2011; Vuidot et al. BC 2011; Regnery et al. FEM 2013)

Does the spatial pattern of the largest trees drive the spatial pattern of the TreMs at the stand level?

Stochastic events

- Neighbour-tree falling
- Lightning
- Wind damages
- Rock fall

Old growth forests

Managed stands

Tree dbh ?

Biotic processes

- Woodpecker drillings
- Between-tree light competition
- Cambium dysfunctioning
- Etc.

Forestry operations

- Tree-marking
- Harvesting injuries

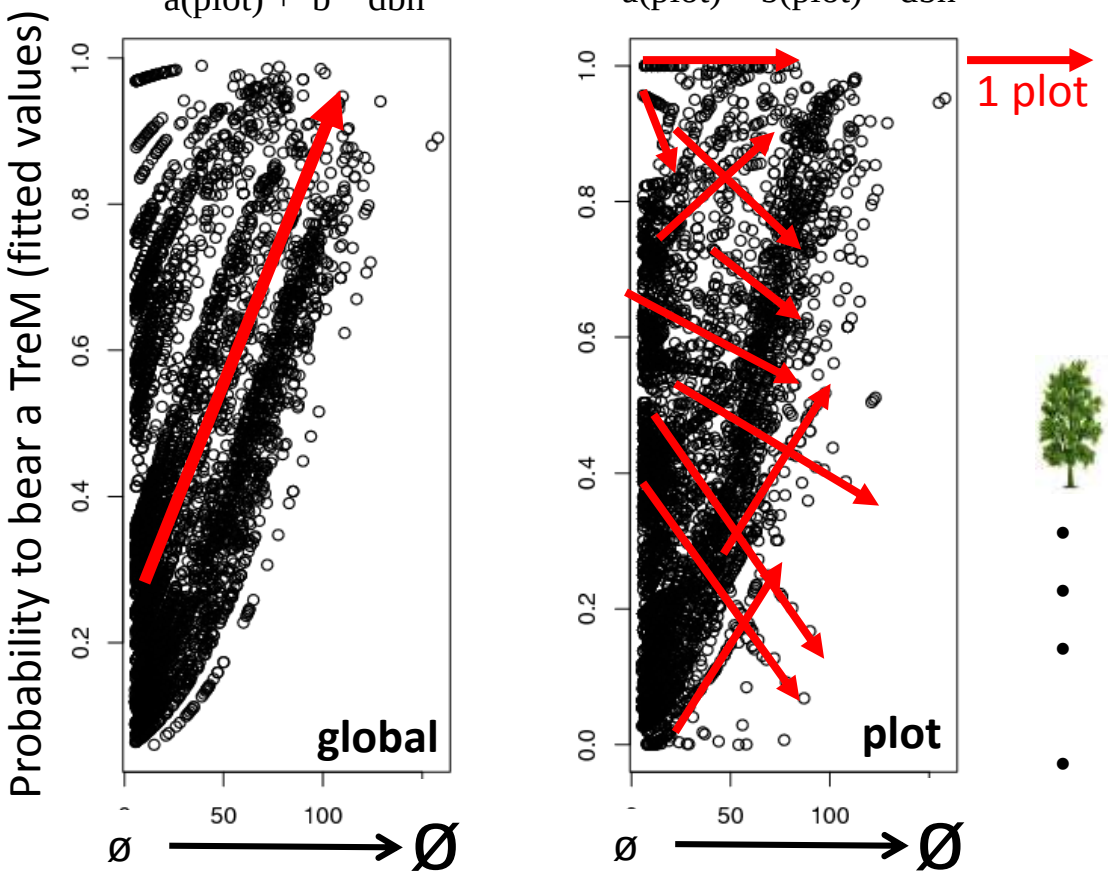
At a multi-site sample level, the probability of bearing a TreM increases with dbh but the direction of this relationship is variable at the plot level

Non-spatialized dbh model

a(plot) + b * dbh

Spatialized dbh model ***

a(plot) + b(plot) * dbh

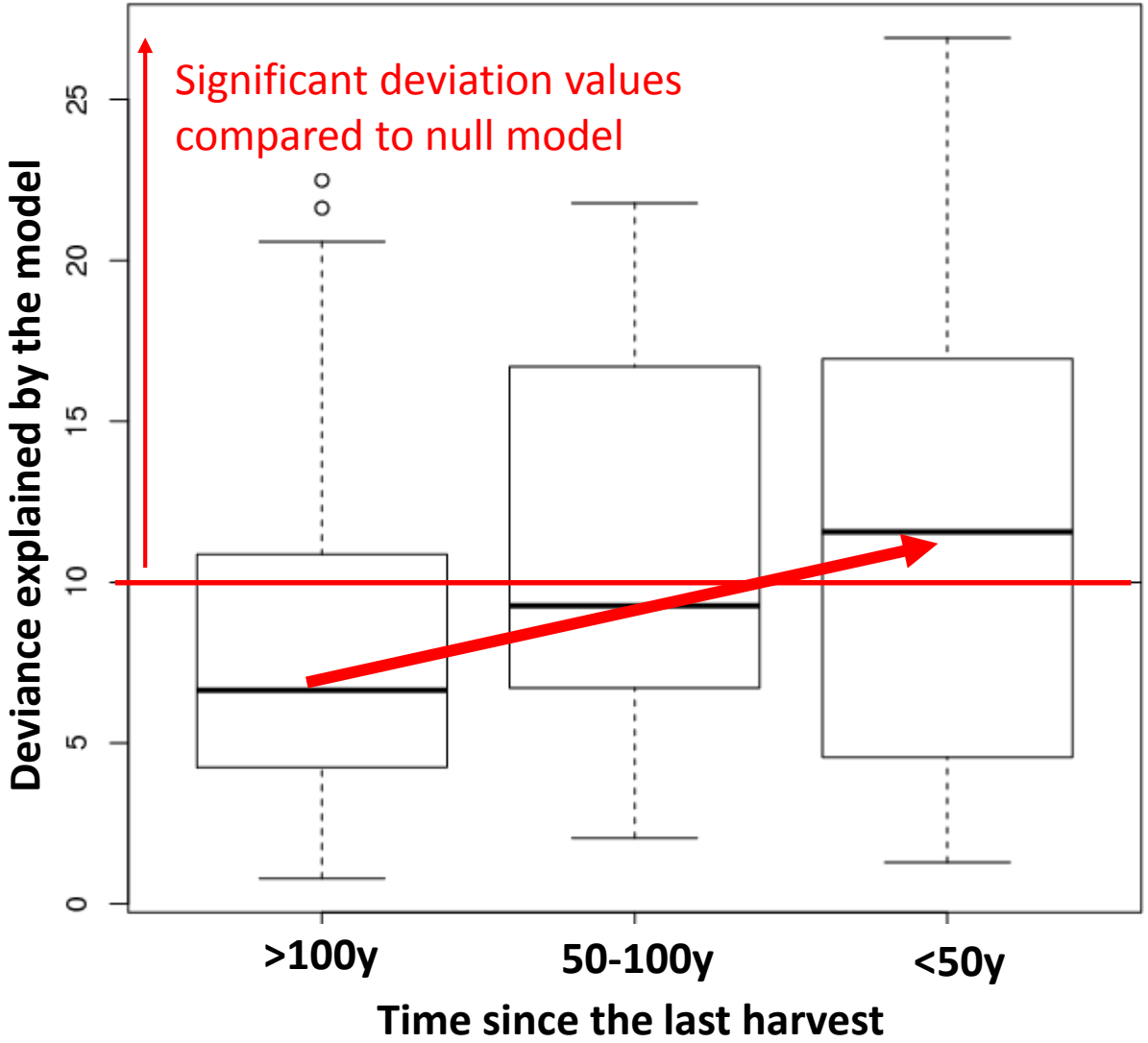


Fagus sylvatica **> 50%**

- **Time since the last harvest > 100 y**
- **5 sites/126 plots/5519 trees**
- **11 TreM groups**

- **GLM binomial** (Y=with a TreM or not)

Time since the last harvest influences the spatial pattern of the TreM-bearing trees



Fagus sylvatica **> 50%**

- **25 sites/165 plots/11425 trees**
- **11 TreM groups**

- **GLM binomial** (Y=with a TreM or not)
- **4 variables describing tree-neighborhood**
  - -d to the closer TreM-bearing tree
  - -d to the closer tree without TreM
  - -nb TreM-bearing trees in a 40m-buffer
  - -nb trees without TreM in a 40m-buffer

Studying spatial distribution pattern of TreM-bearing trees is more challenging than expected…

➢ Some preliminary results

- **No clear and universal spatial pattern** by analyzing a set of 11 TreM groups
- In addition to a dbh effect, there is a **strong site_plot_managing effect**

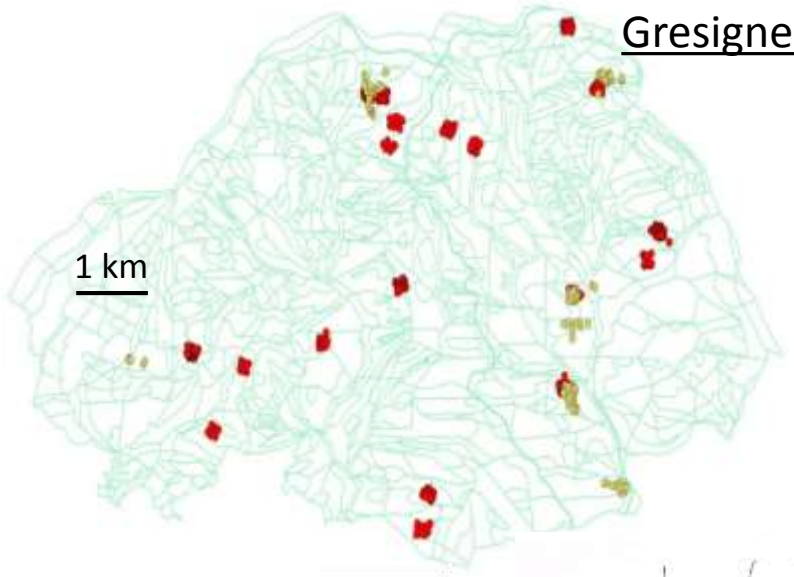
➢ Some methodological challenges in spatial pattern study

- **Scarcity of most of the TreM types** → need of large-area plots with georeferenced trees
- But **changing the spatial extent and the grain size may affects the results** (in agreement with the « Modifiable Areal Unit Problem", Openshaw 1983)
- **Need of additional variables describing the local context**: slope, presence of cliffs, woodpecker assemblages, etc.
- **TreMs are "ephemeral resource patches"** (sensu Finn 2001) → dynamic spatial distribution patterns

Is the dissimilarity of assemblages hosted by tree-cavities related to the between-cavity geometric distance?

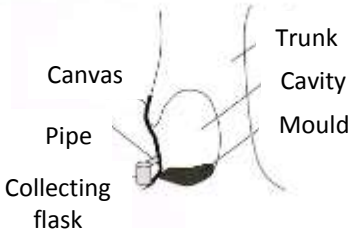
➡ **« distance decay of similarity »** (Nekola & White, 1999)

Gresigne (France)



Quercus petraea

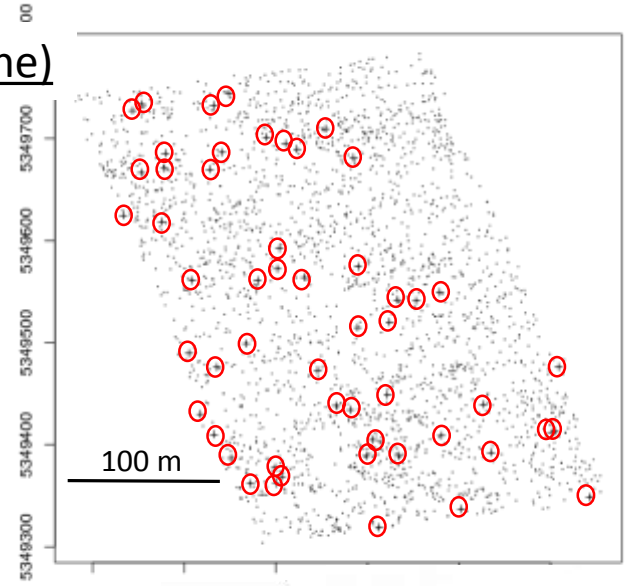
Base rot-holes



189 traps 1year

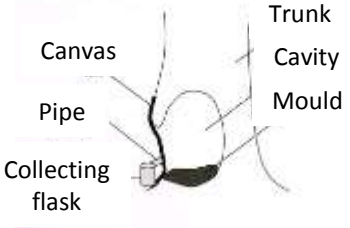
emergence trap

Uholka (Ukraine)



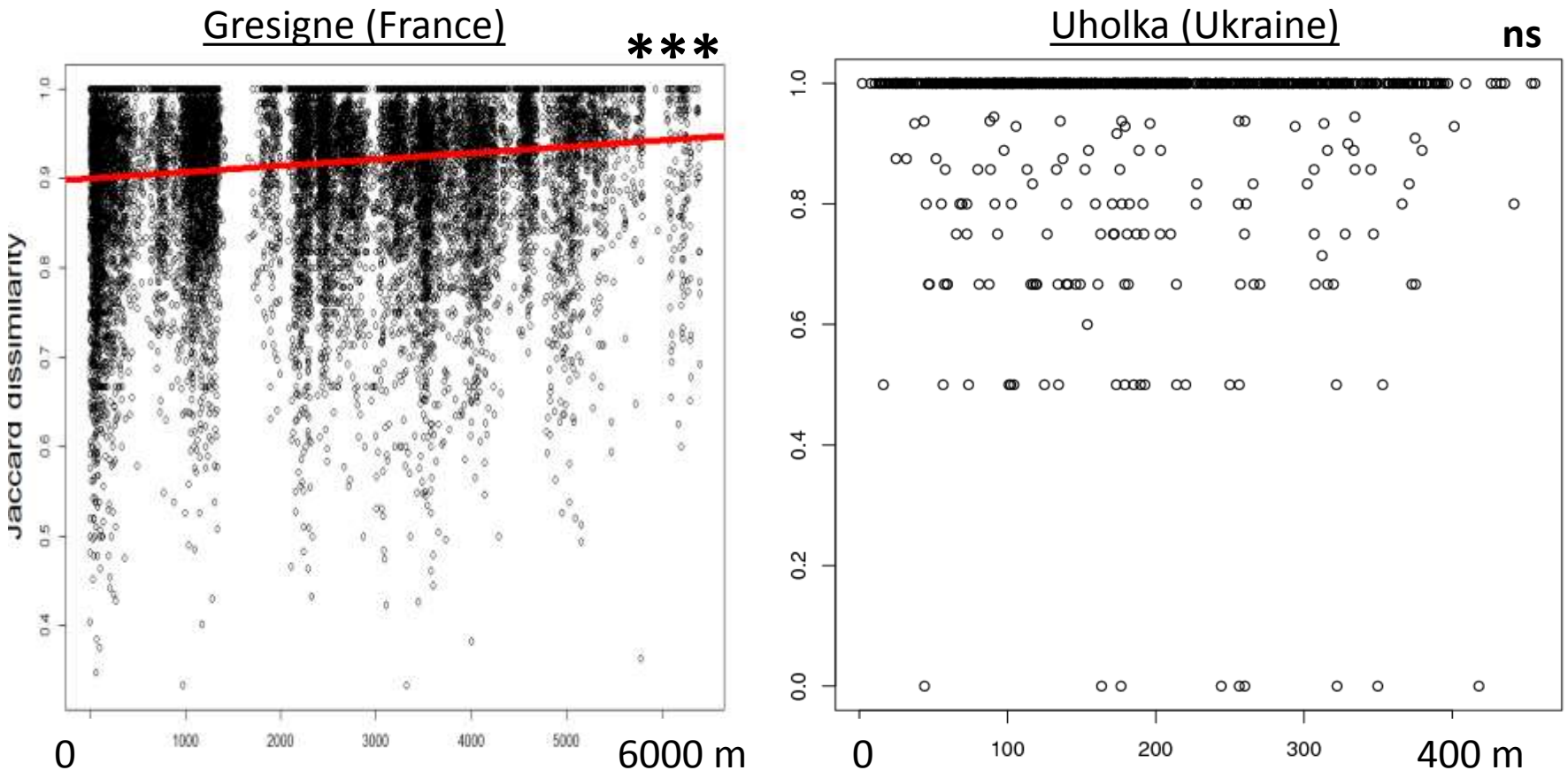
Fagus sylvatica

Base rot-holes



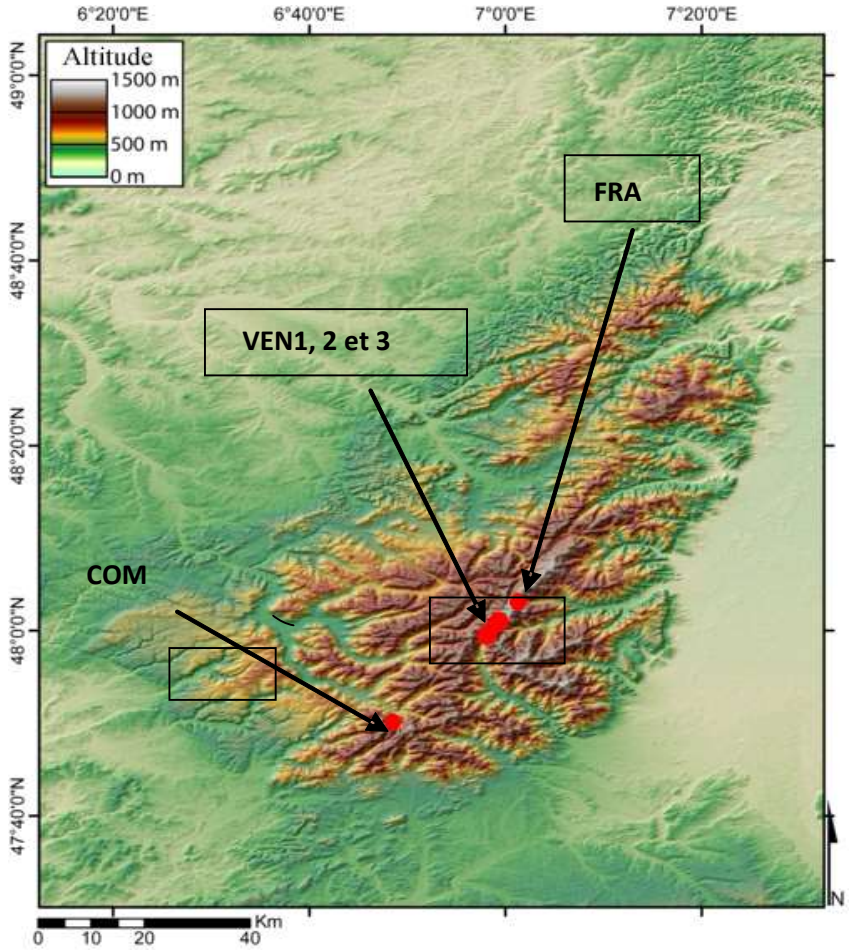
50 traps 1year

The closer, the more similar? The distance decay of similarity pattern for cavity-dwelling biodiversity is not consistent



Does an increasing density of sporocarps at tree or plot scales foster the mean species richness of fungus-dwelling beetles in sporocarps?

The Vosges mountains (France)



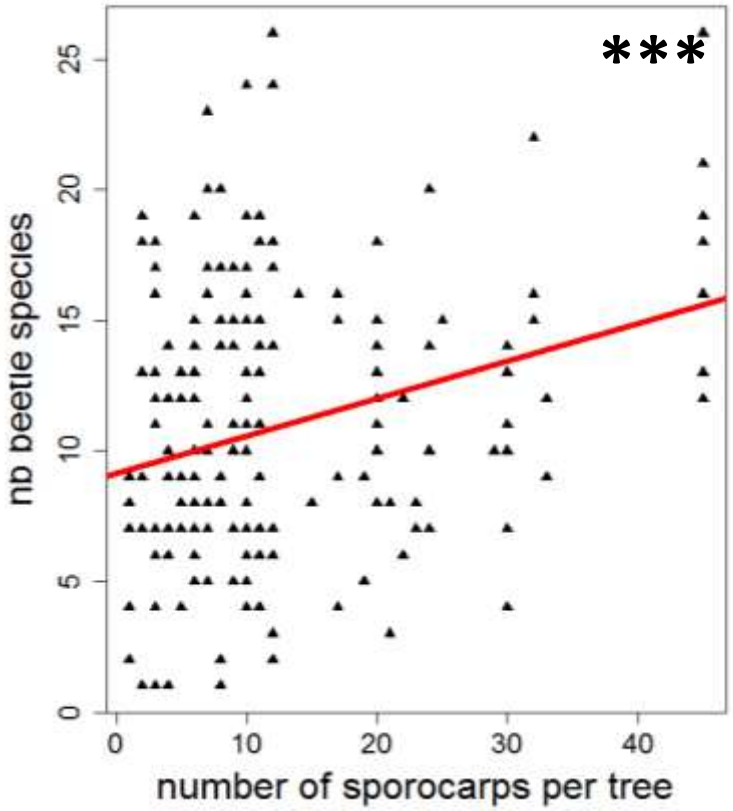
Fagus sylvatica

Fomes fomentarius

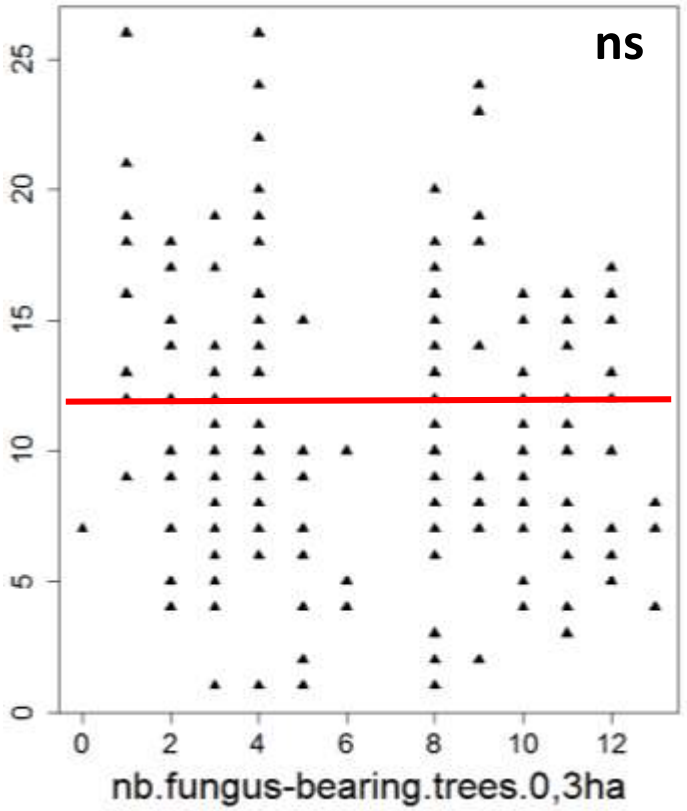
- **196 traps**
- **1 year**

Fine-scale habitat aggregation has a positive effect on the local species richness of fungus-dwelling beetles…

…but neither mass effect nor dilution effect of mid-scale habitat aggregation



Tree-scale



0.3 ha scale

See also Jonsell et al. (1999); Rukke et Midtgaard (1998)

In a nutshell…

- **Other features than tree-dbh should be considered to explain spatial patterns of Trem-bearing trees**

- **Spatial scale of studies strongly influences :**
  - **The relationship between tree-dbh and the probability to bear a TreM**
  - **The relationship between spatial patterns of TreMs and associated biodiversity**

- **Both alpha and beta diversity of TreM-dwelling beetles may be influenced by the spatial distribution of TreMs**

Thank you for your attention