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, Jyväskyla, 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)

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

7 Forms
TReMs are key features for many taxa and participate in a complex functional habitat network in species life cycles.
Large trees bear most of the TreMs within a forest stand (e.g. Larrieu et al. EJFR 2012)

(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?

- Old growth forests
  - Biotic processes
    - Woodpecker drillings
    - Between-tree light competition
    - Cambium dysfunctioning
    - Etc.
  - Stochastic events
    - Neighbour-tree falling
    - Lightning
    - Wind damages
    - Rock fall
- Managed stands
  - Forestry operations
    - Tree-marking
    - Harvesting injuries

Tree dbh?
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:
\[ a(\text{plot}) + b \times \text{dbh} \]

Spatialized dbh model:
\[ a(\text{plot}) + b(\text{plot}) \times \text{dbh} \]

- **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

- 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

**Fagus sylvatica** > 50%

Significant deviation values compared to null model
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)

**Introduction**

**Spatial patterns**

**Old growth forests**

**Managed stands**

**TreM-dwelling taxa**

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

**Graphs showing distance decay of similarity for cavity-dwelling biodiversity**

- **Gresigne (France)**: ***
- **Uholka (Ukraine)**: ns
Does an increasing density of sporocarps at tree or plot scales foster the mean species richness of fungus-dwelling beetles in sporocarps?
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

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

- Other features than tree-db announcement should be considered to explain spatial patterns of TreM-bearing trees.

- Spatial scale of studies strongly influences:
  - The relationship between tree-db announcement 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.