PH.D. Proposal
Dynamics of tree microhabitats in temperate mountain forests:
Use as an indicator of biodiversity
And impact of retention management strategies.

Dates: Octobre 2015 – Octobre 2018

Location and laboratory :

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Summary :

Tree related microhabitats (TReMs) such as cavities, cracks and fungi developing on trunks are used for shelter, nutrition and reproduction by many species of birds, insects and small mammals. They are considered as biodiversity indicators revealing the potential presence of key forest species. Forest dynamic processes (tree growth, mortality and regeneration) and management practices impact TReMs within a stand. TReMs occurrence has been shown to be related to tree size and species. Moreover, TReMs are removed from the stand when trees die or are harvested. The conservation of biodiversity in temperate forests can be improved by management strategies that protect trees bearing TReMs from harvesting (Retention approach of forestry). Retention of several trees per ha is mandatory to get sustainable forest management certificates. However, the dynamics of TReMs is largely unknown. The value of TReMs as biodiversity indicators is limited by the fact that we do not know the durability of these structures. Moreover, retention strategies have been elaborated empirically and many forest managers are reluctant about these approaches because their efficiency, cost and sustainability are unclear.

The objectives of this PH.D are to develop our knowledge about the dynamics of TReMs in temperate mountain forests, to develop a biodiversity indicator related to the flux of TReMs within a stand, and to evaluate retention strategies.

The PhD student will improve a TReMs appearance model we developed in 2014, relating the probability of appearance of a TReMs on a tree during an elementary time step to tree diameter, increment and species in a Bayesian statistical framework. We used a database where TReMs were observed at a single date and all TReMs were combined. The student will join a European effort to develop a standard TReMs database. He will make a second observation of TReMs on trees after 5

years. He will evaluate our model and adapt it to different types of TReMs (top trunk holes vs. foot holes vs. cracks etc.).

The student will then combine this TReMs appearance model with our individual-based simulator of forest dynamics Samsara.2. He will make simulation experiments to analyze how fluxes of TReMs vary among forest stands of different initial structures, demographic rates (growth, regeneration and mortality) and management strategies. These experiments will require the use of statistical methods for numerical experiments such as the design of efficient experimental plans and sensitivity analysis. From this experiment, he will develop an index of biodiversity by relating TReMs distribution characteristics (i.e. number, diversity and distribution among trees of different sizes) to TMH persistency within a stand. He will then evaluate the efficiency (TReMs number and diversity), cost (loss of wood production) and sustainability (balance of TReMs fluxes) of management strategies varying by number, species, size distribution and spatial distribution of retained habitat trees.

The student will then evaluate by simulation management strategies proposed by forest actors in Rhône-Alpes (ONF, CRPF, COFORET, PNR des Bauges). We hypothesize that biodiversity can be improved at low costs by small modifications of these strategies.

Key words :
Simulation, model, sustainable forestry, biodiversity,

Candidate profile :
We seek a candidate interested by forest ecology, forest management, modeling, statistics and numerical experiments. The candidate will have to develop codes using the R statistical software and do field work.

Bibliography:
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Larrieu, L., Cabanettes, A., Brin, A., Bouget, C. & Deconchat, M. (2014a). Tree microhabitats at the stand scale in montane beech-fir forests: practical information for taxa conservation in forestry. *European journal of Forest Research* 133(2): 355-367.
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