Commercial thinning and canopy gaps influence nitrogen cycling in soil of a young forest

David COULOMBE (*david_coulombe@uqar.qc.ca*) & Luc SIROIS

Centre d'Étude de la Forêt

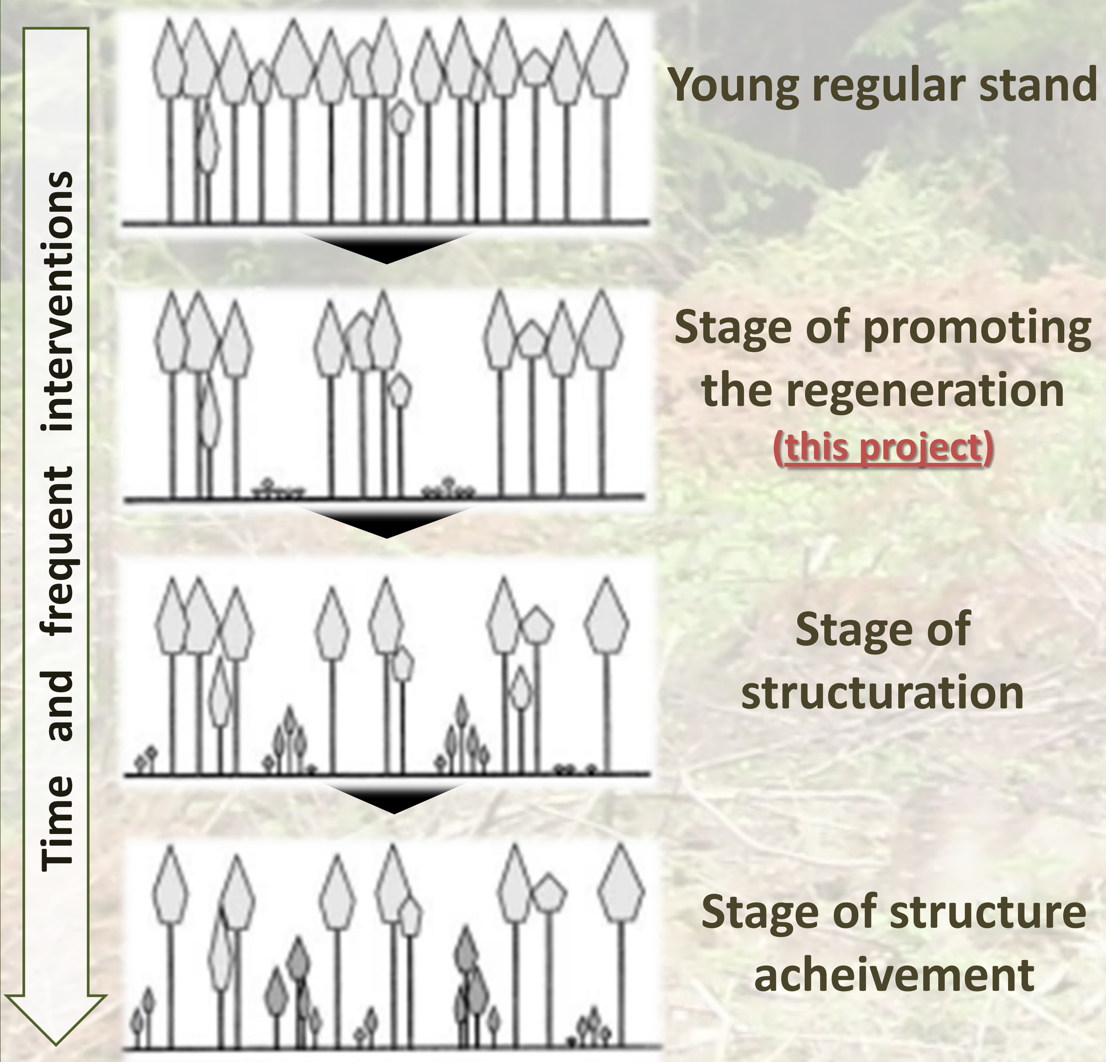
Chaire de Recherche sur la Forêt Habitée, Université du Québec à Rimouski

GOAL : **Investigate soil nutritional conditions after the first step of irregular forest transformation from young regular stands**

1. Context

Forest management

- **Transformation** of a **regular** forest to an **irregular** one with **young balsam fir** dominated stand as a starting point
- This project is a part of **the initiation phase** of the transformation process
- Use of **commercial thinning** (CT) and **canopy gaps** (CG) with **controls** (CTR)



Nitrogen cycling

- Nitrogen availability may play a key role in seedling establishment and DON/NH_4^+/NO_3^- ratio changes may benefit to plants depending of their N requirements

2. Methods

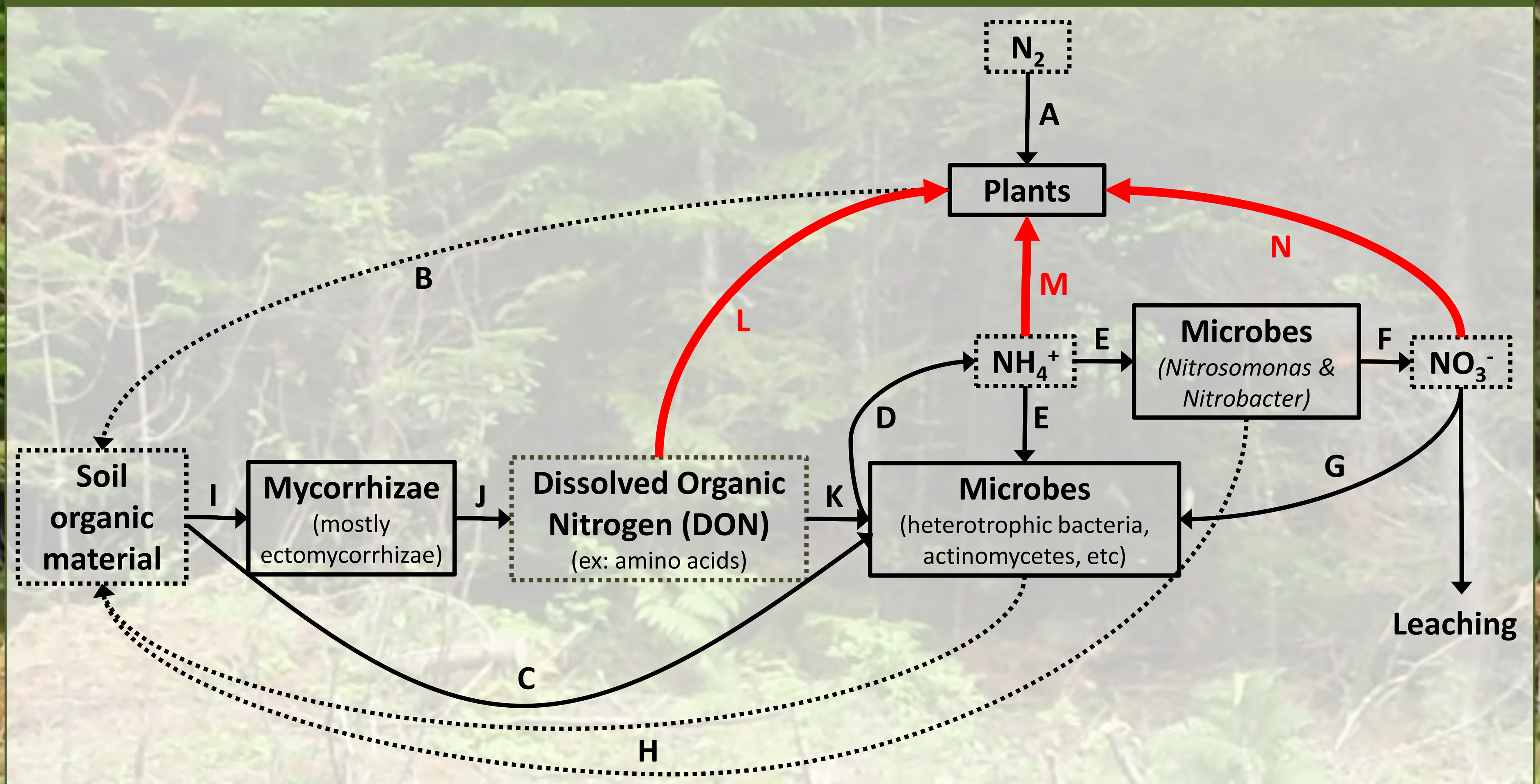
- Replicated 0.75 ha plots (PT) (n=4) with 3 harvesting treatments (TREAT) :
  - Uncut forest (CTR)
  - Commercially thinned forest (CT)
  - 0.05ha canopy gaps (CG)

$$Y_{ij} = \mu + TREAT_i + PT_{j(i)} + \varepsilon_{ij}$$

- 8-weeks *in situ* buried bag incubations of forest floor and mineral soil samples

- Two incubation periods:
  - ✓ Mid-June to early-August (SUMMER)
  - ✓ Early-August to mid-October (FALL)
- Dissolved organic nitrogen (DON), ammonium (NH_4^+) and nitrate (NO_3^-) were measured before and after incubations

3. N cycling in forest



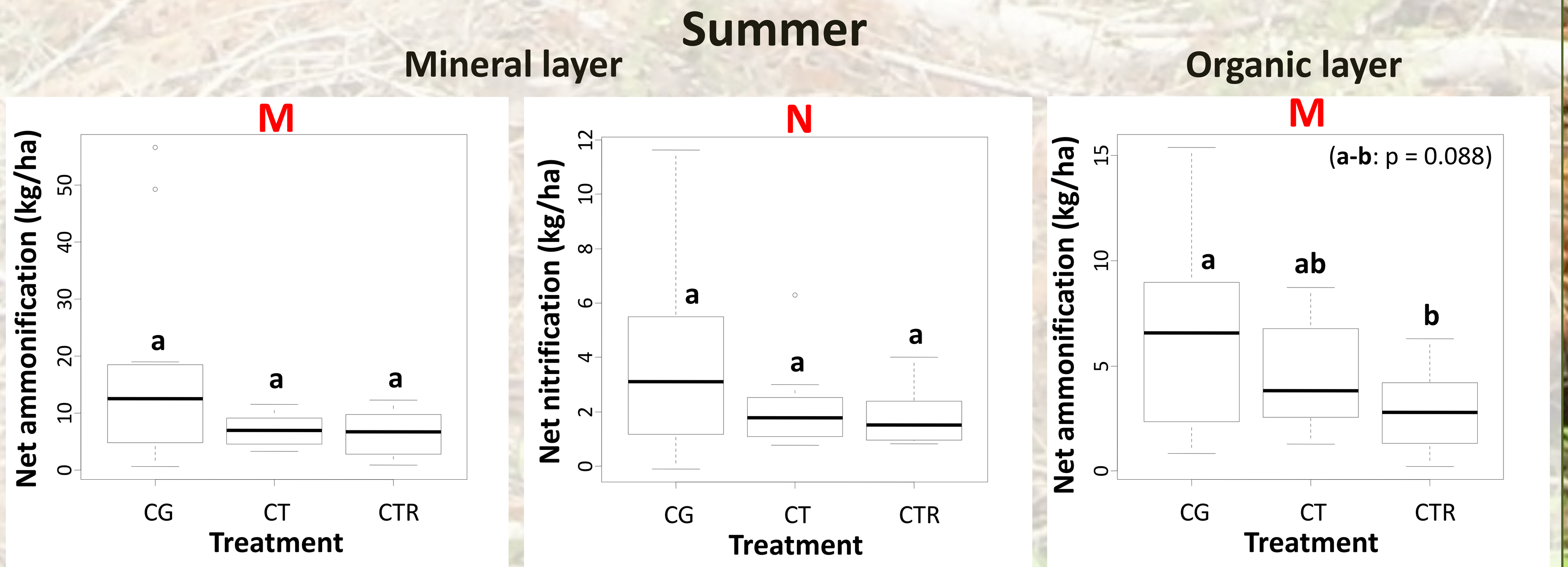
A: N_2 fixation
B: Senescence (roots, foliage, etc.)
C: Organic material decomposition
D: Gross ammonification
E: NH_4^+ Immobilization
F: Gross Nitrification
G: NO_3^- Immobilization
H: Stress, grazing

I: Mycorrhizal activity
J: Gross depolymerisation
K: DON immobilization
L: DON uptake by plants (or net depolymerisation)
M: NH_4^+ uptake by plants (or net ammonification)
N: NO_3^- uptake by plants (or net nitrification)

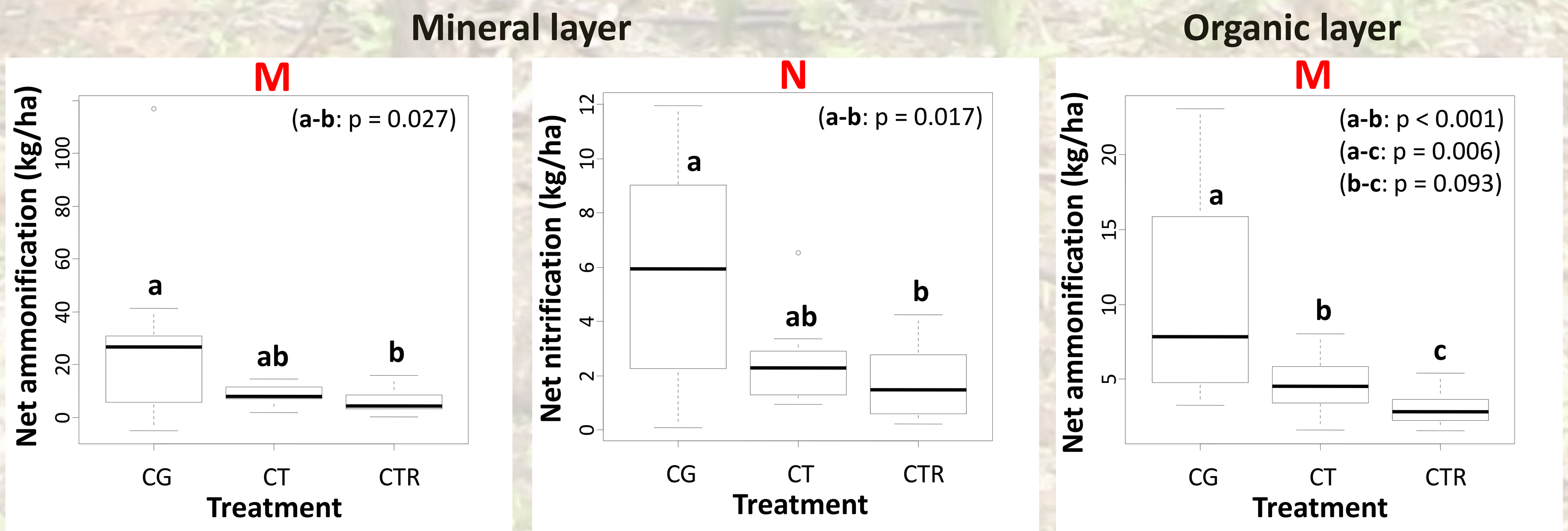
N uptake by plants
N transformation
N transformation (death of organisms)
N pools (abiotic)
N pools (biotic)

4. Preliminary results (letters in RED refers to the N cycling figure)

Summer



Fall



5. Discussion / Conclusion

- **MANOVA** (n = 4) showed that our treatments (CT, CG or CTR) influenced the overall nitrogen cycle (net ammonification (**M**), net nitrification (**N**) & net depolymerisation (**L**)):
  1. Mineral layer summer (p = 0.478)
  2. Organic layer summer (p = 0.097)
  3. Mineral layer fall (**p = 0.011**)
  4. Organic layer fall (**p < 0.001**)
- Differences between treatments were higher in fall than in summer
- Net ammonification (**M**) and net nitrification (**N**) rates were higher in fall than in summer
- No changes were observed for net depolymerisation (**L**) because our incubation experiment killed plants roots and then inhibited ectomycorrhizal activity (**I**)
- Net nitrification (**N**) was nil in the organic layer
- The measured changes allow optimization of the operations that aim to transform an irregular forest structure from young regular stands.
  - ✓ Augmentation of nitrification in the mineral layer suggests that nitrogen leaching may occur in canopy gap if it is not fixed by plants
  - ✓ Plantation of the desired species (*Picea glauca*, *Thuja occidentalis*, *Pinus strobus*) in the understory or canopy gap should be made carefully to avoid increased mortality or competition
  - ✓ Higher flux of N in fall than in summer may guide our decision according to the best suitable period for understory planting

Acknowledgements

Thanks to Mariig Hamon for her help in the laboratory. Thanks to my field assistants : Joé Leclerc-Dufour, Nicolas Cordon and Charles Tremblay. A special thanks to Dr. David Paré (Centre de foresterie des Laurentides) and to Diane Bérubé and Yves Paquin (UQAR) for their precious advices.

CRFH
Chaire de Recherche sur la Forêt Habitée
UQAR

Fonds de recherche sur la nature et les technologies Québec

cef