Climate Change Adaptation: is assisted migration an option to overcome the limited migratory capacity of resinous in boreal forest?

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Introduction

The increase of atmospheric greenhouse gas resulting from human activities could significantly alter the global climate during this century.
The natural rates of migration of forest ecosystems are struggling to keep pace with rapidly changing climatic conditions.
Assisted migration of plants has been proposed as a strategy to reduce the impact of climate change on forest ecosystems.

Objectives

To quantify the effect of tree provenance displacement in terms of survival, growth rate, nutrient status and physiological stress of four tree species in Québec's (Canada) boreal forest.
Assisted migration was also combined to the creation of carbon sinks by the afforestation of boreal open woodlands (OWs).

Material and Methods

3 blocks (replications) planted in 2014 with different provenances of:
- *Larix laricina* (2)
- *Pinus banksiana* (5)
- *Picea mariana* (9)
- *Picea glauca* (4)

Survival and growth measurments were made during two years after planting
Tree foliage was collected for nutrient status and carbon isotopic composition analysis ($\delta^{13}C$)

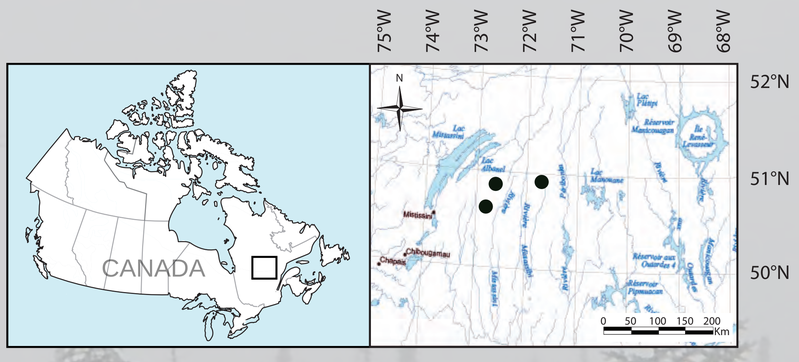

Figure 1. Localisation of the three replicate blocks in Québec (Canada) boreal forest.

Results

After one growing season :

- Survival rates did not differ significantly between species, nor between provenances
- Survival rates for all provenances were all superior to 90%
- Relative growth rate (RGR) did not differ between species
- RGR was higher for one provenance of *P. banksiana* and one of *P.glauca*

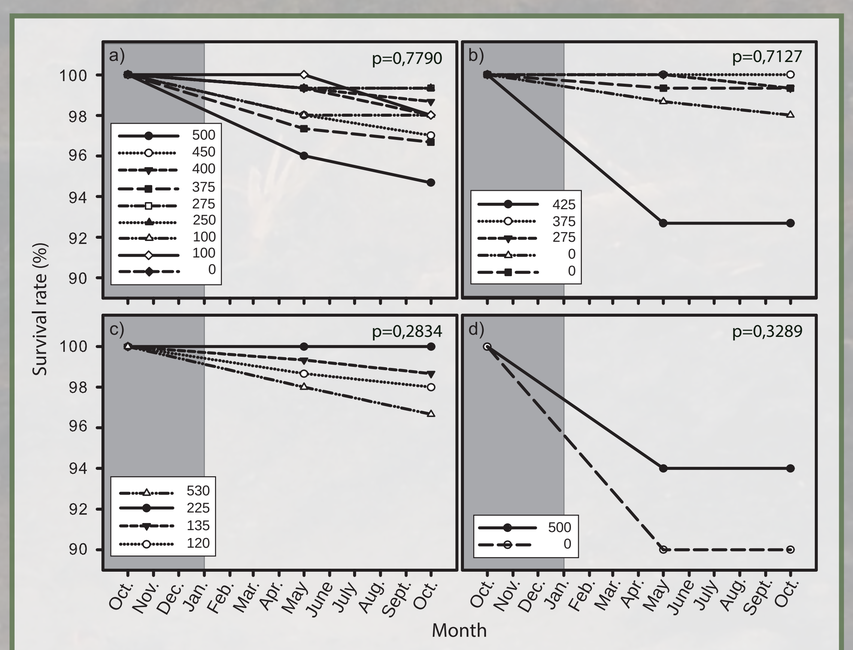

Figure 2. Evolution of the mean survival rate (%) for different displacement of provenance (km shown in legend) of (a) *Picea mariana*, (b) *Pinus banksiana*, (c) *Picea glauca* and (d) *Larix laricina*. The darker gray area represents the year 2014 (up to two months after plantation) and the area in light gray represents the year 2015.

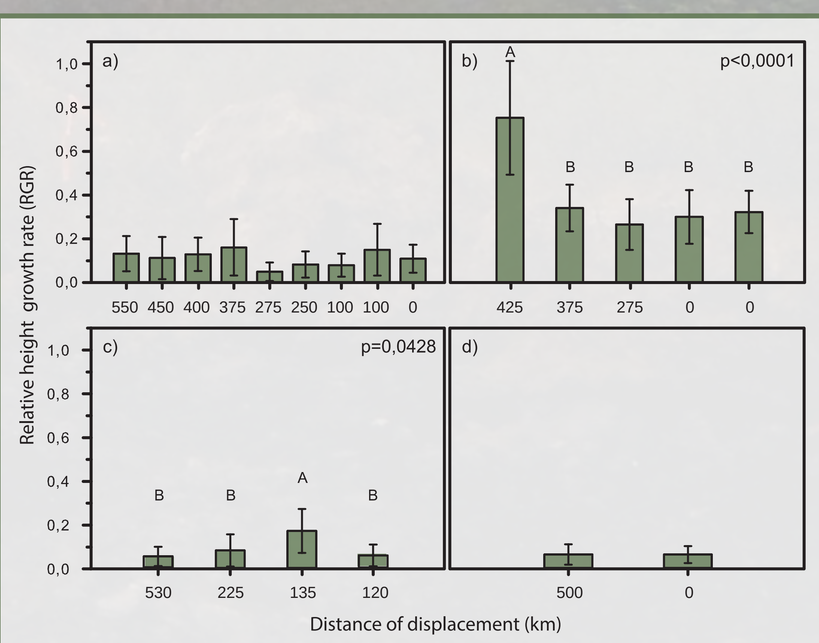

Figure 3. Relative height growth rate by the distance of displacement (km) for different provenance of (a) *Picea mariana*, (b) *Pinus banksiana*, (c) *Picea glauca* and (d) *Larix laricina*.

Preliminary results

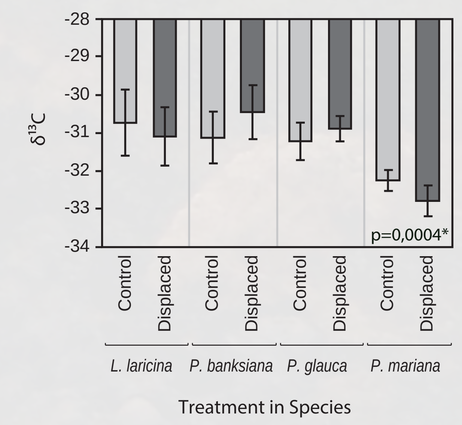

Figure 4. Carbon isotope composition ($\delta^{13}C$) of four tree species. The control represents a local provenance (displacement of 0 km and the displaced represents an average displacement of 500 km.

Conclusion

These early findings provide no evidence that there is an impact of the displacement of provenances for three of the four species.

A single provenance of *P. banksiana* did differ compared to the control provenance. This suggests that this provenance that was displaced northerly by 425 km, seems already able to acclimate to the northern boreal forest.

Results also suggest that *P. mariana* does not present an optimal stomatal control of transpiration in a climate change context.

This study could provide forest managers with new information about assisted migration in boreal OWs, the acclimatization of species to climate change, altogether contributing to the future health and productivity of forests.

Preliminary results on carbon isotopic composition suggest :

- No significant differences between provenances
- 8% difference between the most distant means
- *P. mariana* showed a higher discrimination against ^{13}C

References

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