



Can forest management help increase forest migration rate northward to follow climate change? A theoretical model approach

Willian Vieira (1,2), Daniel Houle (3,4), Dominique Gravel (1,2)

(1) Département de biologie, Université de Sherbrooke, 2500 Boul. De l'Université, Sherbrooke, Québec J1K 2R1, Canada, (2) Québec Center for Biodiversity Science, Montreal, QC, Canada, (3) Direction de la Recherche Forestière, Ministère des Forêts, de la Faune et des Parcs du Québec, 2700 Einstein, Québec City, Quebec G1P 3W8, Canada, (4) Consortium sur la Climatologie Régionale et l'Adaptation aux Changements Climatiques (Ouranos), 550 Sherbrooke W, Montreal, Quebec H3A 1B9, Canada

Global change is impacting the distribution and productivity of northern forests. In higher latitude forests, such as in Québec (Canada), we expect forest species to migrate northward to follow the increase in temperature. But because of the long-life cycle and low dispersal distance of trees, Québec's dominant tree species are lagging behind their optimal climate niche and maladaptation may therefore occur. Forest management may alternatively accelerate forest migration towards the north and increase their adaptation to climate change. However, the interaction between forest management and climate change in controlling ecological processes and species range shifts is still poorly understood. Here, we used a State Transition Model to investigate the potential of forest management to increase the northward migration rate of Québec's dominant tree species. The model considers four states: boreal forest, temperate forest, mixed-wood forest and regenerating forest stands. The proportion of boreal and temperate tree species in regenerating forest stands depends on the ecological processes of colonization, succession, competitive exclusion and disturbance. Management practices such as plantation, enrichment planting, thinning and harvesting were then integrated in the model by varying, respectively, these four ecological processes. Primary results show a potential of forest management to increase forest adaptation to climate change. More specifically, enrichment planting and thinning were the more effective practices to increase the migration rate northward. Accounting for ecological processes in our model allowed a more realistic prediction of the trees' range distribution at the regional scale comparing with statistical models. However, attention to interactions between forest management and ecological processes at the local scale are still needed. These potential outcomes may also help predict the impact of management practices, interacting with climate change, in forest productivity.

keywords: dispersion; forest management; forest resilience; productivity; ecological processes