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# In Brief

from the Canadian Forest Service – Laurentian Forestry Centre

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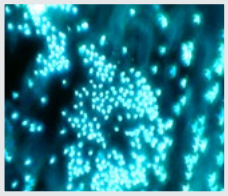


## Translocation of white spruce seed sources: Does it affect lumber quality?

The transfer of tree seeds from the southern to northern locations has been widely recommended as a forest management strategy to mitigate the impacts of environmental change on forest growth. However, its effect on lumber quality remains unknown.

Canadian Forest Service (CFS) researchers evaluated the effect of seeds' geographic provenance on the growth and quality of lumber from 108 white spruce trees harvested at maturity. In the 1960s, seeds from various sources had been planted by the CFS in two contrasting geoclimatic environments in eastern Canada.

*Photo: NRCan*

Results showed that provenance had a significant influence on growth and lumber strength in the first sawlog but had no effect on lumber stiffness and wood density. As the average volume production per tree at the southernmost site was twice that of the production at the northern site, assisted gene flow strategies should aim to maximize volume productivity in northern sites for efficient carbon sequestration. The authors also recommend that breeding programs should aim to prevent a decrease in lumber stiffness due to augmented productivity and shortened rotation cycles.

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## What drives the extreme wildfire seasons in the Tłı̨chǫ First Nation territory?

In recent decades, the increase in temperatures linked to climate change has resulted in more frequent, more extensive wildfires with drastic effects on forest ecosystems in northwestern Canada. In 2014, more than 3.4 million hectares were destroyed by wildfires in the Northwest Territories, in contrast to an average of 600,000 hectares annually between 2009 and 2019. The 2014 fires burned 20% of Tłı̨chǫ First Nation territory, illustrating that Indigenous communities are particularly affected by forest fires, which compromise their activities within the territory and jeopardize culturally significant areas.

Researchers from the Université du Québec en Abitibi-Témiscamingue, the Université de Montpellier, and the Canadian Forest Service have identified and characterized the spatial and temporal component distributions of extreme wildfire years (EWY) on Tłı̨chǫ First Nation territory between 1965 and 2019. They documented nine EWY in the territory, including 2014, and showed that temperature and fuel moisture content were the main drivers of areas burned. More specifically, EWY were distinguished by a mean temperature higher than 14.7 °C as well as by Drought Index, Initial Spread Index, and Fire Weather Index values all exceeding threshold values.

The results of this work could inform forest management actions aimed at limiting the negative effects of extreme wildfires on cultural sites and on ecosystem services beneficial to the Tłı̨chǫ community and to neighbouring communities.

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## What effect does ramial chipped wood have on the microbial communities in degraded soil?

Reforestation of degraded lands in the boreal forest is a major challenge in poor soils, which are unfavourable to vegetation recovery. The restoration of these sites depends on plant-soil feedback, i.e., the effect that plants have on the composition and activity of soil microorganisms and the effect that these soil microorganisms have on soil nutrient fluxes and plant fitness. To foster this kind of synergy, the use of ramial chipped wood (RCW) to stimulate microorganism activity was tested and provided very promising results.

In order to better understand the mechanisms underlying the positive effect of the addition of RCW, a team of researchers from Agriculture and Agri-Food Canada, the Université du Québec en Abitibi-Témiscamingue, the Université Laval, and the Canadian Forest Service has investigated the links between soil microbiome taxonomic and functional diversity, soil and tree nutrient stocks and concentrations, and tree productivity in borrow pits. This research was conducted in a reforestation area established 17 years ago with several RCW treatments.

Results showed that adding RCW to plots can create conditions favourable to initiating positive plant-soil feedback in unproductive soils in the boreal region. Applying wood mulch in plots rather than around individual trees encouraged the recruitment of bacterial and fungal taxa that enhanced the availability of nutrients. This led to a more rapid restoration of the disturbed forest ecosystem.

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*This publication is part of a series that presents popularized summaries of scientific articles written in whole or in part by Laurentian Forestry Centre researchers.*

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## Soil Carbon Cycle and Global Warming in the Boreal Region

The boreal region contains the largest soil organic matter stocks, and the soils in this region are the richest in carbon. Prediction models of the effect of global warming on soil organic carbon (SOC) stocks differ as to whether these stocks will remain stable in a warmer climate. Therefore, additional experimental data are needed to refine SOC modelling according to climate change scenarios in the boreal region.

It is against this backdrop that Canadian Forest Service researchers assessed soil carbon pools and fluxes in 22 forests in Quebec's humid boreal region. These sites are located along an annual temperature gradient ranging from -0.7 °C to 3.3 °C and dominated along the gradient by balsam fir and black spruce.

*Photo: NRCan*

In this study, significant acceleration of carbon fluxes through litterfall and soil respiration was observed along the climatic gradient while the quantity of soil organic matter remained unchanged. The authors suggest that warmer temperatures had no effect on SOC stocks, despite an acceleration of the carbon cycle, for two reasons: forest composition along the gradient did not change, and the gradient's warmest conditions did not reach a threshold of aridity that would affect SOC gains and losses differently, as observed in more arid regions.

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## Is the spraying of *B.t.k* as effective on white spruce as it is on balsam fir?

*Photo: NRCan*

Aerial applications of *Bacillus thuringiensis* (*B.t.k*) organic insecticide significantly reduce the damage caused to balsam fir by the eastern spruce budworm. But to what extent are these treatments effective on white spruce, an extremely economically valuable host to the spruce budworm?

Researchers at the Université Laval, the Société de protection des forêts contre les insectes et maladies, and the Canadian Forest Service have been examining this question. They compared the efficacy of three types of *B.t.k* application (early application, late application, and double application) in reducing budworm defoliation of white spruce and balsam fir in mixed stands.

The results of this study do not show a difference in efficacy between early and late application, which suggests that the time window for insecticide application is greater than one week. Additionally, results show that spraying was less effective on white spruce than on balsam fir. The protection approach has been optimized for balsam fir and adjustments to spray prescriptions will be needed to obtain better results for white spruce, especially on plantations. For instance, treatments could be more effective after the bud cap, which shelters budworm larvae for longer on white spruce than on fir, falls off. Additionally, the size and the density of *B.t.k* droplets should be adjusted so that a lethal quantity can be delivered to a high proportion of spruce needles.

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## Does transplanting moss work to restore non-productive forests?

Following natural disturbances in boreal regions, the surface area occupied by low-productivity open lichen woodland frequently increases at the expense of woodland that contains more productive mosses. This transformation is accompanied by soil depletion and by a decrease in stand density and productivity. To counteract this trend, researchers at the Centre for Forest Research and the Canadian Forest Service have assessed the impact, after 10 years, of transplanting moss into plots of open lichen woodland.

The results of this research suggest that it is possible to replace lichen cover with moss cover, which can establish itself, survive, and remain healthy. This transplantation has had beneficial effects on water and nutrient availability. However, the study showed that lichen removal as a method of increasing productivity does not appear to be a good approach, as it had a negative effect on tree growth. Nevertheless, the feasibility of transplanting mosses over large areas and the long-term survival of mosses needs to be evaluated.

As another measure for restoring moss cover, the authors suggest dense plantations which foster low light conditions in the understory, an environment more favourable to the growth of mosses.

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