Natural Resources Canada | Ressources naturelles Canada

In Brief

from the Canadian Forest Service – Laurentian Forestry Centre

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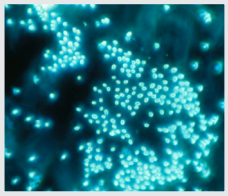


Are mixed forest stands better carbon sinks than pure stands?

Researchers with the Canadian Forest Service, Lakehead University and the Université du Québec en Abitibi-Témicamingue set out to answer this question by quantifying aboveground carbon pools in black spruce and trembling aspen mixtures in the eastern Canadian boreal forest, as well as in jack pine and trembling aspen mixtures in the central Canadian boreal forest.

Their conclusion is unequivocal: no carbon gain is associated with species mixtures. Nearly pure trembling aspen stands contained the greatest amount of aboveground carbon, black spruce stands had the least, and mixtures were intermediate with amounts that could generally be predicted as a function of the proportion of each species.

These results suggest that, for trembling aspen, the potentially adverse effect of black spruce on soils may be offset by greater light availability in mixed forest stands. On the other hand, for black spruce, the potentially beneficial effects of trembling aspen on soils could be offset by greater competition by aspen for light and nutrients. The mixture of jack pine and trembling aspen did not benefit either of these species, and it induced a loss in trembling aspen carbon at the stand level. Aspen biomass was smaller than that predicted based on data from pure stands.

Research is currently being done on the effect of species mixtures on the total ecosystem carbon pool, including soil carbon, and the results will be used to complete this assessment.

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Does CO_2 have a fertilization effect on Canada's boreal forests?

Increasingly, modellers are incorporating the CO_2 fertilization effect into the evaluation of the impact of climate change on forests. Rising atmospheric CO_2 appears to have a positive effect on net primary productivity (NPP) due to the increased availability of carbon, a nutrient that is often a limiting factor in photosynthesis. Although this fertilization effect has been demonstrated repeatedly under laboratory and controlled conditions, what is the case for natural forest environments?

Researchers with the Canadian Forest Service, Université Laval and the University of Winnipeg compared bioclimatic model simulations of NPP with tree ring data (1912–2000) from jack pine trees growing in Manitoba. They observed an increase in forest growth associated with increased length of the growing season and greater availability of soil water. No CO_2 fertilization effect on growth was detected, suggesting that this effect was much smaller than expected.

In view of this finding, should the CO_2 fertilization effect be incorporated into models used to predict future forest growth? The researchers concluded that data from controlled experiments cannot be extrapolated to large forested areas without a good understanding of the constraints on growth, which requires pertinent inventory and tree ring data. Further research is being carried out to verify whether these results apply to Canada's boreal forest as a whole.

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Improving prediction of conifer growth in plantations

Researchers with the Canadian Forest Service's Canadian Wood Fibre Centre, Université Laval and the ministère des Ressources naturelles et de la Faune du Québec (MRNF) developed biophysical site index models for seven plantation-grown conifer species in Quebec. The site index is usually estimated using phytometric models based on the age-height relationship. This method cannot be used to predict the site index when information on the stand is unavailable, as is often the case for sites targeted for reforestation.

Photo: R. Gal

These biophysical models were developed to estimate the site index and the expected productivity of plantations. They incorporate a number of variables: degree-days, aridity, summer precipitation, vapour pressure deficit, and soil water-holding capacity. Permanent plot data from the MRNF's network of plantations, together with existing site indices, were used to build the models. The results show that the models have a good capacity for predicting timber volume yields from plantations, and that there are few correlations between phytometric and biophysical indices.

The biophysical models developed for white spruce, black spruce, Norway spruce, tamarack, eastern white pine, jack pine and red pine could be used for strategic planning at the landscape level to estimate plantation yields.

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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.

Canada

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Effects of small-scale disturbances in the boreal mixedwood forest

In the boreal mixedwood forest, small-scale disturbances make an important contribution to maintaining understory vegetation diversity. These disturbances influence vegetation composition by increasing species diversity and abundance (cover) and they allow pioneer species to co-exist with species associated with old-growth forests. This rich understory vegetation diversity increases the likelihood that more diversified regeneration will occur following large-scale disturbances.

These are the findings of a study undertaken by researchers with the Canadian Forest Service, the Université du Québec en Abitibi-Témiscamingue and the Université du Québec à Montréal in balsam fir–white birch stands in the Abitibi region. Artificial canopy gaps representing three different levels of severity (clear-cut, conifer cutting, and girdling of conifers) were created in a 100 m^2 area of mature and old-growth forest stands. Data were collected before treatment and 1, 2 and 11 years after treatment. The increase in understory vegetation abundance was proportional to the degree of canopy opening, and the effects were still visible during the last data collection.

Photo: L. De Grandpré

The purpose of this experiment was to mimic small-scale disturbances such as insect-induced damage and blowdown. The results show the important contribution that such disturbances make to understory species diversity and abundance even in late successional forest stages.

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Birds and post-fire salvage harvesting

The composition of burned stands after salvage harvesting influences the habitat occupancy of different categories of birds. For example, balsam fir and intolerant hardwoods attracted more passing migratory birds and foliage insectivores, but fewer omnivores. Black spruce and jack pine, on the other hand, attracted resident birds and bark insectivores.

Photo: J. Ibarzabal

Fire severity also has an influence on the presence of bird species. A slightly burned forest attracts bark and foliage insectivores, whereas a severely burned forest is more attractive to cavity (snag)-nesting, ground-nesting and shrub-nesting birds, as well as ground foragers.

These are some of the findings of studies conducted by researchers with the Canadian Forest Service, the Canadian Wildlife Service, the Université du Québec en Abitibi-Témiscamingue and the Université du Québec à Chicoutimi, who conducted a study in the black spruce–feather moss forest of western Quebec. In this research, they modelled occupancy probability for different bird species based on habitat characteristics.

The knowledge acquired from this research will be used to enhance post-fire salvage harvesting by permitting enhanced evaluation of the ecological value of the stands in the mosaic of burned forest.

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Forest genomics challenge: accelerating genetic selection

In a forest genomics study on white spruce, researchers with the Canadian Forest Service's Canadian Wood Fibre Centre, Université Laval and FPInnovations achieved a first by linking the presence of certain genetic markers to desired wood quality traits in this economically important species.

Tree breeding is a lengthy process, particularly with regard to selection of wood traits. For example, wood density varies during tree growth, and it can take up to 20 years to obtain a valid estimate of this characteristic. Early selection based on the use of genetic markers associated with wood density will reduce the duration and costs of testing considerably and increase genetic gains per unit of time, while also enhancing selection accuracy.

In this major study, the researchers examined nearly 500 30-year-old white spruce to identify associations between 25 wood quality traits and 549 candidate genes. The results, which show that a number of markers explain an appreciable percentage of the variation in wood traits, represent significant progress toward the identification of genes that control wood quality and the development of genetic markers for early molecular selection.

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