Natural Resources Canada | Ressources naturelles Canada

In Brief

from the Canadian Forest Service – Laurentian Forestry Centre

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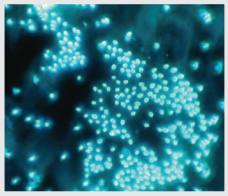


A model for evaluating the impact of temperature increases on the carbon cycle of forest soil

According to certain estimates, two-thirds of terrestrial carbon is found in the litter and organic matter in the forest soil. Carbon reserves in forest soil could be equivalent to double that of all atmospheric carbon.

Could the temperature increase associated with climate change accelerate the decomposition of terrestrial carbon, increasing carbon emissions into the atmosphere? Forest soils have a natural tendency to accumulate some organic matter of which carbon is the main component. On the other hand, the increase in annual average temperature can result in a higher production of forest litter, a component of the forest ecosystem containing significant amounts of carbon.

In a recent study, Canadian Forest Service researchers sought a better understanding of what becomes of carbon reserves in the forest soil. They developed a simulation model to predict the impact of temperature increases on the terrestrial carbon in maple, fir and spruce stands in eastern Canada.

Without confirming a substantial increase of carbon emissions in the atmosphere, the preliminary results of the simulations indicate structural changes in the terrestrial carbon reserves. Additional work will be necessary to improve the efficiency of the model.

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Lodgepole pine - Resistance of the European breed to scleroderris canker

Scleroderris canker, which is indigenous to North America, is a disease spread in the red pine plantations of Quebec. The infection penetrates new shoots on low branches and can be controlled by simple preventive pruning. The more harmful European strain of the disease can affect the tops of red pines and cause the death of trees.

By conducting trials in natural conditions, we were able to demonstrate that the lodgepole pine, native to the Rockies, is resistant to the European strain of scleroderris canker. When attacked by the pathogenic agent, the trees create new tissue and manage to restore cambial activity in spite of the attack. The traumatic resin canals seem to help their defense system.

A recent study by researchers at the Canadian Forest Service and Université Laval led to a better understanding of the defense mechanisms of trees to the European strain of scleroderris canker. The researchers planted lodgepole, jack and red pines near already infected red pines. Observations on the progression of the disease were made over a period of five years and confirmed the resistance of the lodgepole pine. The resistance of jack pine had already been established.

The European strain of scleroderris canker is widespread in Europe and in the American northeast. In Quebec, it affects plantations of red and Scots pines in particular. These results put an end to the catastrophic scenario that predicted the possible destruction by this disease of lodgepole pine forests concentrated in western Canada.

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Canadian forests - New understandings of carbon sequestration

The capacity of forests for carbon storage is frequently mentioned in discussions on the current problem of climate change caused by the increase in the concentration of carbon dioxide in the Earth's atmosphere.

Rapidly growing forests are the best at capturing and sequestering carbon. About 15 researchers, including two from the Canadian Forest Service, have just completed research into the productivity of forest ecosystems in Canada. This research is aimed at better understanding the contribution of Canadian forests to carbon fixation.

Photo: P. Bernier

Several ecosystems were studied: forests recently disturbed by cutting or fire, young forests, forests of intermediate age, mature coniferous and deciduous forests, and peatlands. In all these ecosystems, the maximum productivity for carbon fixation was reached at midday. Recently disturbed forests had the lowest productivity. The highest carbon capture rates were for coniferous forests of intermediate age (35-60 years). Furthermore, the productivity of young forests was greater if they originated from a fire than if they originated from harvesting. Understanding forest development seems to be the key to better understanding their productivity and capacity to capture atmospheric carbon.

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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

In Brief
from the Canadian Forest Service – Laurentian Forestry Centre

Estimating biomass with satellite imagery

A new method, based on the projection of tree shadows, was developed by researchers at the Canadian Forest Service and the Université de Sherbrooke to estimate and map the biomass in the black spruce forests of eastern Canada. The method is of special interest for large taiga areas where forest inventory data is not available. Since carbon is a major component of biomass, there is great scientific interest in estimating it.

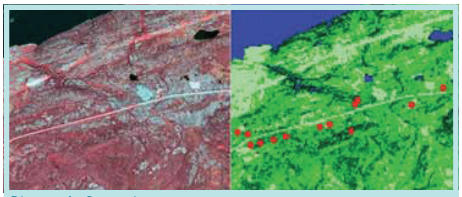

Photo: A. Beaudoin

The researchers used high resolution satellite imagery (HRSI) as an alternative to the aerial photos traditionally used for forest inventory work. The shadows cast by the trees were proportional to several structural variables, such as diameter at breast height, tree height or crown diameter. On a given area of the image, they calculated the total proportion of the area covered by tree shadows and then used it in a mathematical equation to calculate the total biomass per surface unit.

To validate these calculations in the field, three complementary trial sites were chosen: the first was situated near Radisson, the second near Chibougamau and the third near Wabush in Labrador. The method allows us to estimate biomass with satisfactory precision for black spruce stands that are around 20 m in height and 70% density in a biomass range between 0 and 150 tonnes per hectare. The method is being fine-tuned with CFS colleagues across the country in order to apply it to other boreal species.

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Which sites are sensitive to biomass harvest?

In Quebec, there are two commonly used methods for harvesting biomass: whole tree harvesting (WTH) where the tree is cut down and hauled to the roadside, depriving the forest site of most of the cutting residue (branches, foliage and crowns); and stem only harvesting (SOH), where the tree is cut down, pruned, topped down to the stump, and the cutting residue left at the site. Because of growing interest in the use of cutting residue for production of biomass energy, we have reconsidered the impact of cutting on the functioning of forest ecosystems.

A Canadian Forest Service researcher, in association with colleagues at Université Laval and the University of Saskatchewan, compared the impact of these two harvesting methods on soil fertility and nutrition of trees under a variety of conditions and on a number of boreal species. The results indicated that 15 to 20 years after harvest, WTH, as opposed to SOH, reduced the capacity of the soil to store certain nutrients. Other effects were only visible on certain types of soils. For example, WTH reduced concentrations of organic carbon in soils with a coarse texture and low in organic matter, increasing the nutritional deficiencies of regenerating soils already poor in mineral composition. This was especially true for jack pine, a species with a rapid juvenile growth.

The richness of the soil and the type of tree species growing after cutting are good indicators of site sensitivity where there has been intensive harvesting of forest biomass. These results suggest that using fixed budget input and output of nutrients such as those used by Paré et al. (2002), could be misleading in certain cases: these budgets do not take into account the nutritional strategies of species regenerated after harvesting and do not necessarily take into account certain parameters that can make the site fragile, such as soil organic matter content.

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Weevil infestation of Norway spruce - Lumber quality and quantity not affected

Between 1965 and 1995, over 200 million Norway spruce were planted in Quebec. After repeated infestations by the white pine weevil, forest managers drastically reduced planting this species. The damage caused by the weevil is noticeable: formation of forking/crotches, curving, bayonets or multiple stems. However, research done by the Canadian Forest Service and the ministère des Ressources naturelles et de la Faune du Québec showed that even when affected by white pine weevils, Norway spruce plantations still produce saw timber of good quantity and quality.

The researchers analyzed the production resulting from the second commercial thinning done in three plantations in the Quebec City region. It was shown that trees seriously affected by weevils had lower volume productivity (14.7%) and were of lower quality (23.7%) compared with unaffected trees. However they considered that the decreased volume for the entire cutting cycle, including the final amount, was limited to about 3% of the total amount produced during a single cutting cycle. The first thinning periods eliminated the most seriously affected trees and enabled the production of crop trees only mildly affected by the weevil.

The researchers also compared the results from one of these plantations with those from a plantation of white spruce. They were surprised to see that in spite of the presence of weevils, the bulk production was higher for Norway spruce and generated a higher yield of saw timber (26%). This positive difference would explain in part the less pronounced tapering of Norway spruce.

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