Natural Resources Canada | Ressources naturelles Canada

In Brief

from the Canadian Forest Service – Laurentian Forestry Centre

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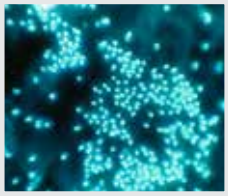


Studying tree growth in 3D

The annual rings of a tree's growth are visible when the tree is cut down or when a wood core is extracted. The width of these rings varies depending on a tree's growth rate, and several factors affect this rate: climate, attacks by insects, soil fertility, etc. The measurement of growth rings is used by researchers to assess damage to trees from environmental impacts, among other things, and to determine prior climate.

Researchers from McGill University and the Canadian Forest Service have developed a new approach to study the growth of white spruce in three dimensions using sections of the stem. This method makes it possible to obtain data at a sufficiently small scale to allow the delineation of reliable limits for annual rings that are large enough to study variation on the outside of the ring and variation from one ring to the next for growth rates.

The technology used is computer-assisted tomography, which provides millions of data for one stem section, which can be mapped. This new approach allows researchers to conduct detailed studies of the growth of trees and makes it possible to obtain data such as wood density at various stem heights. This technique is currently being applied in the laboratory, but as instrument sizes become smaller, it will potentially be possible to take these measurements in the forest, without cutting trees.

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Pan-Canadian soil maps

In Canada, the provinces and territories are responsible for managing their forests and performing inventories based on their specific needs. Because of this, the data collected vary from one province to the next, which becomes an obstacle when studying trans-border forest issues (e.g. insect outbreaks). Agriculture and Agri-Food Canada have produced soil maps covering all of Canada. These maps mainly cover agricultural land, and are imprecise and difficult to use for commercial forest areas. The National Forest Inventory (NFI) partially addresses this gap by compiling and harmonizing provincial and territorial inventories and point data on soil properties from field plots. However, the NFI only covers 1% of Canada's landmass, while continuous mapping is needed to analyze one or more forest issues.

In order to eliminate this limitation, researchers from the Canadian Forest Service developed pan-Canadian soil maps. They used a mosaic of pixels at a resolution of 250 m x 250 m as a basic grid. Some of these pixels contain data on soil properties. Applying a statistical technique (*k*-nearest-neighbours or *k*NN) makes it possible to use this information to estimate several properties of forest soils throughout Canada's commercial forests.

The soil maps thus generated will facilitate several applications, and serve to determine the most sensitive sites and those most suitable for biomass harvesting. The maps can be superimposed directly over forest attribute maps developed by the CFS since they were produced using the same basic grid.

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Terrain configuration influences fire regimes

In any given area, a fire regime is characterized by the area burned, the severity of fires, their recurrence and their abundance. In eastern Canada, different fire regimes exist that are influenced by complex interactions between regional climate, topography and the amount of available fuel. However, the size of fires is often the only spatial attribute considered.

Researchers from the ministère des Forêts, de la Faune et des Parcs du Québec, l'Université du Québec à Montréal, l'Université du Québec en Abitibi-Témiscamingue and the Canadian Forest Service explored new spatial attributes – the direction of fires and terrain configuration – and the connections between these and regional physiography. They found that fires are larger on terrains with configurations that allow prevailing winds to spread the fire, because there are no natural barriers to slow them down. However, when the direction of physiographic and water drainage patterns is perpendicular to prevailing winds, thus creating natural firebreaks, the fires are smaller.

This study highlights the fact that regional terrain configuration plays an important role in the expanse of forest fires. This latest factor could have an impact on our understanding of the ability to extinguish fires in certain parts of a territory, as terrain configuration can amplify the difficulty of combatting these fires and make it difficult to establish firebreaks.

In regions where terrain configuration is conducive to large fires, the ability to maintain sustainable forest management may be limited due to the difficulty of controlling these fires.

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Hybrid poplars with exotic components: well adapted in Quebec

Hybrid poplars have been planted in eastern Canada over the last century, especially as ornamental or windbreak trees. Several of these had an exotic component, meaning that they were derived from a cross between a native poplar and a poplar from outside of Canada (exotic). To better understand the potential dispersion of exotic genes into the environment, researchers from Umeå University and the Canadian Forest Service examined the ability of native poplars (pure or hybrid) and hybrid poplars with exotic components to transmit specific characteristics to their descendants.

Photo: NRCan

Thus, in a natural stand located in an urban area in eastern Canada, the researchers collected data on the success of regeneration, seedling growth, germination rates and seedling vulnerability to disease. By comparing the characteristics of parent trees and their descendants, they concluded that hybrid poplars with exotic components have characteristics that are found in both parents and that they are not significantly different from native hybrid poplars.

These results indicate that hybrid poplars with exotic components have adapted to environmental conditions; in urban areas, their seedlings successfully establish themselves in natural stands, and do so despite competition.

These studies provide a better understanding of the environmental impact associated with the presence of hybrid poplars with exotic components, whether it be the loss of genetic integrity in compatible native species, or impacts on the biodiversity of associated species.

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Biomass: indicators of site sensitivity to harvesting

There is a growing interest in the use of biomass derived from forest harvesting residues. These residues mainly include the top and limbs of trees harvested during traditional forestry operations. This increase in demand for forest biomass has also sparked a debate on the impacts of biomass harvesting on the productivity of forest soils and stands.

Several guidelines exist throughout the world to protect soil fertility when harvesting forest residues. Few of these recommendations are based on empirical data. It is important that the evaluation of site response be based on evidence rather than on opinions. The objective of this study was to develop and validate indicators that can be used to predict the sensitivity of sites to residue harvesting based on field studies conducted across Canada.

Researchers from the Nova Scotia Department of Natural Resources, the Ontario Ministry of Natural Resources, the British Columbia Ministry of Forests and Range and the Canadian Forest Service were able to determine indicators that provide the best information on site sensitivity. These indicators were developed using empirical data from experimental sites established in the 1980s and 1990s by universities, provincial governments and the federal government.

These simple and reliable indicators, which serve to predict site response to biomass harvesting, are total nitrogen concentration, total phosphorus concentration and organic carbon concentration in the mineral soil. These data can be mapped.

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Studying windthrow in order to imitate it

Windthrow is an important natural disturbance in the boreal forest of eastern Canada. Researchers from Université Laval and the Canadian Forest Service examined the spatial distribution of partial windthrow (PW, i.e. less than 75% of forest cover affected) and total windthrow (TW, more than 75% of forest cover affected) at the landscape scale, in three study areas on the North Shore. The researchers also studied the distribution of residual trees within the affected stands. Windthrow spatial characteristics (size and shape) were also compared with the spatial characteristics of harvested areas.

At the landscape scale, the results showed that TW stands were more isolated than PW stands and openings created by logging were more homogeneous than those created by windthrow. At the stand scale, the researchers noted that there were far more residual trees in PW stands than in harvested and TW stands.

In the context of ecosystem-based forest management aimed at reducing variations between natural and managed forests, the results of these studies will help forest managers to develop silvicultural treatments of different intensities to approximate natural disturbances.

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