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In Brief

from the Canadian Forest Service – Laurentian Forestry Centre

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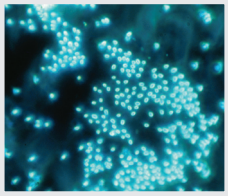


Landscape composition has an impact on plant succession in boreal forests

Researchers at the Canadian Forest Service and the Montreal Campus of the University of Quebec have compared the composition and distribution of post-fire vegetation of adjacent ecoregions in the boreal forest and attempted to identify factors that may explain the differences observed in plant succession in these ecoregions.

The studied ecoregions, one of mixed boreal forest and the other of coniferous boreal forest, are located in the western part of the province on the Quebec-Ontario border and belong to the bioclimatic domains of balsam fir-white birch and black spruce-moss.

Using a network of plots, the researchers gathered data on forest composition, types of surface deposits, drainage and fire history. Their analyses revealed the main factors that may explain the differences observed in stand composition, such as types of surface deposits and amount of time since recent fires.

However, the results show that these two factors do not fully explain the observed differences and that landscape composition has a direct effect on stand succession, particularly because it has a partial impact on the size and severity of fires.

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A silvicultural approach more suited to boreal forests

An ecosystemic approach to boreal forest management usually compares the effects of forest cutting with those of natural disturbances, particularly forest fires. But for a group of researchers made up of scientists from the Canadian Forest Service and the Montreal Campus of the University of Quebec, it is important to point out the limitations of this analogy. The researchers have studied the fire regime and its repercussions on the dynamics of forest stands in part of the mixed and coniferous boreal forest on the Quebec-Ontario border. They found significant variations in the frequency and duration of fire cycles over a period corresponding to two millennia. These variations would explain the diversity of composition and structure of the forest they studied. They say that this finding has major implications in terms of forest management.

With the current approach to boreal forest management, based on the assumption that boreal forest fire cycles are short cycles, there is a tendency to reduce the diversity of ecosystems as seen in their natural state. In fact, the researchers noted that there were also long fire cycles. They suggest as an alternative that a silvicultural approach based on natural boreal forest dynamics be used, an approach that is different for mixed forests and for coniferous forests. It would help preserve stands associated with old-growth forest, with total cuts applied to some stands and partial cuts to others.

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Defining old-growth forests within boreal forests

Old-growth forests play a major role in maintaining biodiversity, but they disappear when an even-aged harvesting system is used to standardize forests. This type of management is perhaps not the best management strategy to use to protect these forests. Researchers at the Canadian Forest Service and the Montreal Campus of the University of Quebec would like to propose a definition of old-growth forests that would apply to all North American boreal forests. This definition would take into account the dynamic nature of the development of these forest stands and could be useful for conserving and managing them more effectively.

In that regard, the researchers suggest that the longevity of species and regional fire cycles be assessed. At the stand level, the old-growth stage is characterized by smallscale disturbances that engender gap dynamics. They also say that the quantity of oldgrowth forests in the regions is dependent on fire cycles, which are longer in some regions of Canada than in others. They therefore define the start of the old-growth stage as occurring when the initial post-disturbance cohort begins dying off, concurrent with understorey stem recruitment into the canopy.

Photo: S. Gauthier

Both management and conservation strategies must take into account that old-growth forests are dynamic in their relationships with the disturbance histories of various boreal regions. To be effective, reserves should contain all stages of development and be sufficiently large to encompass rare but large disturbances. The abundance of old growth in many boreal regions of North America also suggests that forest management strategies other than even-aged, fully regulated systems have to be developed.

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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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Gap dynamics and replacement patterns in gaps of the Northeastern boreal forest of Quebec

Quebec's North Shore boreal forest is characterized by a humid climate. Consequently, fires are less frequent and small-scale disturbances play an important role in forest dynamics. Natural mortality and nonfire disturbances such as insect outbreaks and windthrow lead to gap-driven processes. Changes in structure and species composition can result from gap dynamics.

The objective of researchers at the Canadian Forest Service and the Montreal Campus of the University of Quebec was to obtain a better understanding of the dynamics of disturbances of old-growth conifer stands in Quebec's North Shore Region in order to characterize gaps and examine variations in composition and patterns of species replacement.

They found that an average of 54% of the forest was in expanded gaps and that canopy gaps were relatively small, since 87% of them were smaller than 100 m^2. They also found that the replacement process was characterized in pure stands by selfreplacement (balsam fir replacing balsam fir and black spruce replacing black spruce), whereas reciprocal replacement occurred in mixed stands of balsam fir and black spruce, with balsam fir replacing black spruce and black spruce replacing balsam fir.

Photo: L. De Grandpré

These results will increase our understanding of the region's natural disturbance dynamics and serve as a basis for developing silvicultural practices that preserve the structural components of older forest stands.

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Do ecological region and drainage have an impact on the site quality index of black spruce?

Estimating site productivity is a fundamental component of any empirical or functional growth model of a site. Until now, the site quality index (SQI), or the height of dominant trees at a specified age, was an indicator very often used to estimate the productivity of a site because there was a close correlation between the volume and height of dominant trees.

To use the SQI in a model, it is necessary to (1) estimate the SQI using the equation between height and current age and (2) estimate the height at a given age using the equation between the age and the SQI. The prediction error in Step 1 is therefore related to the prediction error in Step 2. In addition to this problem of correlation between two equations, there are two other problems: autocorrelation between the height data resulting from stem analysis and the increased gap between height and age.

The usual statistical methods, such as the least-squares method, cannot be used to provide accurate answers. To find a solution, Canadian Forest Service and Statistics Canada researchers had to use the Generalized Method of Moment (GMM) in order to appropriately answer the question: Do ecological region and drainage have an impact on the site quality index of black spruce? This can be demonstrated using the GMM method.

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For a better understanding of the nitrification process in boreal forests

Nitrification, or the biochemical oxidation of ammoniacal nitrogen in nitrate nitrogen or nitrates, is a complex process associated with nitrogen loss, soil acidification and the appearance of vegetation composed of so-called competitive species in regenerating forests. To more effectively identify this process and its regulating factors, two researchers, one from the Canadian Forest Service, the other from the Montreal Campus of the University of Quebec, studied the relationships between type of forest stand and nitrification in the case of five types of mixed boreal forest stands. They also experimentally verified the effects of altered pH, availability of ammonia and the impact of allelopathic substances on the overall assessment of nitrification.

In the experiments that were carried out, nitrification seemed to vary considerably not only from one stand to another, but also within the same stand. The researchers developed the hypothesis that some species (jack pine and aspen) may have the capacity to modify soil conditions and therefore promote or reduce nitrification. The experimental alterations of pH confirmed that pH level is the factor with the greatest impact on nitrification. The researchers still have to explain the role played by other factors.

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