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# InBrief

from the Canadian Forest Service – Laurentian Forestry Centre

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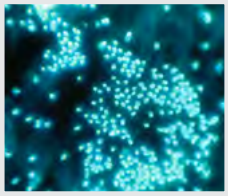


## Partial cutting in the boreal forest: the right choice for biodiversity

Partial cutting, with its objective of preserving 55% of the forest cover, makes it possible for a larger percentage of insects to survive than the harvesting with regeneration protection (HARP) and harvesting with protection of small merchantable stems (HPSMS) methods.

This is the conclusion reached by researchers at the Canadian Forest Service and Université Laval in a study conducted in Quebec's North Shore region. The study's objective was to compare two groups of insects living in old growth boreal forests that had never been harvested with insects in stands subjected to four types of cutting: HARP, HPSMS, and two types of partial cutting. In areas where HARP and HPSMS were applied, 70% to 90% of the forest cover had been harvested, compared with 43% in areas where the two types of partial cutting were used.

The researchers found a greater diversity of insects in the partial cutting areas than in areas where the other types of cutting were done, and that the degree of diversity in the partial cutting areas was closer to that found in virgin old growth forests. Dead tree conservation in partial cutting areas promotes the presence of certain species of insects that are absent in stands subject to HARP or HPSMS because these trees are less abundant in such stands.

The reduced number of openings in the forest cover in partial cutting areas helps to preserve a greater number of closed environment insects that are characteristic of old growth forests, whereas the greater number of openings in the forest cover resulting from HARP and HPSMS reduces the presence of closed environment insects, but increases that of open environment insects.

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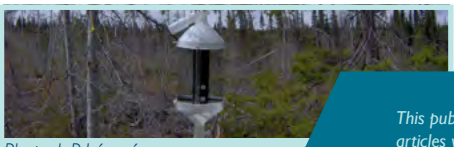

*Photo: J.-P. Légaré*

## Fire regimes have an influence on forest succession

Forest fires, the main disturbance in boreal forests, play a large role in generating a diversity of ecosystems by creating forest mosaics of varying compositions and ages. Researchers at the Canadian Forest Service, the Université du Québec en Abitibi–Témiscamingue and the Université du Québec à Montréal have verified whether or not variations in fire frequency over large areas of the boreal forest have an effect on post-fire forest composition and succession.

The researchers reconstructed the fire history and studied the composition of a North Shore region forest using 160 sample plots distributed over 1.6 million hectares. They found that there are several mosaics subject to various regimes in the same region and that it is possible to identify areas of low and high fire frequency.

In the high fire frequency areas, both young and old stands are dominated by black spruce. In the low fire frequency areas, stands dominated initially by intolerant hardwoods and then by balsam fir are the most frequently observed.

On some sites, the succession from black spruce to balsam fir can be observed over much longer periods than those covered in dendroecological reconstructions (200–300 years). In these cases, the increased presence of fir trees promotes recolonization by intolerant hardwoods when a fire occurs.

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## Heat causes release of $CO_2$ from forest soil

The soil of boreal forests contains vast quantities of carbon. To determine whether or not stand composition influences the quantity of carbon stored in the soil and the stability of carbon sinks, researchers at the Canadian Forest Service, the Université du Québec à Montréal and Lakehead University carried out experiments in the Abitibi–Témiscamingue region.

Soil temperature varies according to the type of stand. This factor is more important than the degradability of organic matter when it comes to explaining the differences in soil carbon emissions between stand types. In conifer stands, soil temperature is lower, notably because of the smaller quantity of light that reaches the ground and the layer of moss that develops on its surface. This moss layer constitutes good insulating material when it is dry and is slow to heat up when it is moist. Carbon emissions are therefore higher in mixed black spruce and trembling aspen stands and in pure trembling aspen stands than in black spruce stands. Through the effect it has on soil temperature, stand composition therefore has an impact on the maintenance of carbon sinks.

The study also suggests that disturbances (for example, forest fires or logging) result in greater soil carbon emissions in conifer stands than in hardwood stands.

This work highlights the fact that forest composition has an impact on the carbon cycle of forest soil in terms of both the quantity of stored carbon and the permanence of carbon sinks.

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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

InBrief

from the Canadian Forest Service – Laurentian Forestry Centre

## Forest biomass: A good choice, if you know how to count

Producing energy from forest biomass rather than from fossil fuels has the advantage of reducing greenhouse gas emissions, but this reduction is not immediate. For this reason, it is necessary to agree on a methodology for measuring the benefits and the time required for a bioenergy project to achieve its reduced emissions objectives.

Compared with oil-based heat production, the combustion of biomass releases a surplus amount of greenhouse gas emissions from smokestacks. The benefit of using biomass is derived entirely from the carbon dynamics occurring in the ecosystem in which the biomass is harvested. Most of the time, simulation models are used to estimate these dynamics. To dispel the great uncertainty associated with these models, Canadian Forest Service researchers used data from a Canadian network of towers that continually measure $CO_2$ exchanges between forest ecosystems and the atmosphere.

*Photo: J.-P. Bérubé*

They were thus able to estimate that if the biomass comes from tree stems harvested at maturity, the "payback time" for these surplus emissions can be up to 90 years. However, the payback time will be shorter for forests where growth is faster and will amount to just a few years if logging waste is used. These calculations should also take into account the likelihood that natural disturbances or logging for purposes other than biomass harvesting may occur, in addition to the consequences of these events for ecosystem-wide greenhouse gas emissions.

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## Is there competition or mutual support between species in mixed stands?

Several factors, including age and environment (soil, water, etc.), influence interactions between various plant species. These interactions become more complex at the stand level.

Researchers at the Canadian Forest Service, the Université du Québec en Abitibi–Témiscamingue and Lakehead University sought to verify whether there is a positive or negative interaction between species in two types of mixed stands: one consisting of trembling aspen and black spruce (Abitibi) and the other of trembling aspen and jack pine (Ontario).

Trembling aspen and jack pine are shade intolerant species, while black spruce is shade tolerant. The researchers wanted to verify whether or not trembling aspen influenced the growth of spruce and whether or not, in the case of the two intolerant species (trembling aspen and jack pine), this interaction was neutral.

The research conducted helped determine that there is indeed an inter-specific influence between trembling aspen and spruce, whether negative or positive, and that it changes over time according to the stand development stage. For example, black spruce does not grow as well alongside trembling aspen at an early stage, but grows better at an advanced stage than in a pure stand. They also noted that there is no benefit to be obtained for biomass production or storage by putting two intolerant species together.

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## Impact of biomass harvesting in boreal and temperate forests

The search for renewable energy sources has sparked greater interest in forest biomass extraction, especially in the form of logging waste.

Researchers at the Canadian Forest Service and the Université du Québec en Abitibi–Témiscamingue have carried out a review and in-depth analysis of scientific articles published around the world in order to determine the site and soil conditions under which the removal of logging waste and tree trunks may have an impact on soil productivity compared with the harvesting of tree trunks only. The objective was to identify general trends in the large number of existing studies and thus provide forest stakeholders with biomass harvesting guidelines.

The researchers concluded that climate, both at the regional and microsite levels, soil fertility (soil grain size, organic matter content, types of minerals contained in the soil), and regeneration characteristics are good indicators of the sensitivity of sites to productivity loss following biomass harvesting. For example, sandy soils with low organic matter or phosphorus content are at greater risk of deterioration. Long-term field monitoring of the actual effects of this practice under a range of site conditions and tree speices is required in order to validate and fully develop these indicators.

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