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In Brief

from the Canadian Forest Service – Laurentian Forestry Centre

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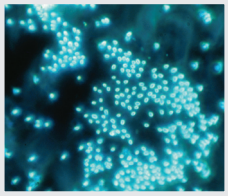


Special Issue on Climate Change

Coniferous forest soils will release carbon more readily than deciduous forest soils

Under the projected global warming conditions, coniferous forest soils should release carbon into the atmosphere more readily than deciduous forest soils. This is the main finding of a study conducted by researchers at the Canadian Forest Service and Université Laval, which involved assessing the impact of global warming on soil carbon in various forest ecosystems.

The soils in northern coniferous forests act as carbon sinks. Warmer temperatures are expected to promote the decomposition of organic matter, thereby increasing the release of CO_2 into the atmosphere. On account of different factors, earlier reports in the scientific literature assumed that soil carbon in coniferous forests would be less sensitive to global warming.

Soil samples taken from two sugar maple sites, two balsam fir sites and a black spruce site were incubated in growth chambers at 3, 10, 15 and 22°C. The results show a similar increase in the rate of decomposition in the humus layer of all forest ecosystems. However, the proportion of carbon that is released into the atmosphere is greater in coniferous forest soils than in deciduous forest soils.

Globally, the increase in carbon emissions from forest soils could accelerate the current warming trend. According to the researchers, the increase in the rate of decomposition is likely to be accompanied by an equivalent increase in biomass production.

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Selecting white spruce provenances adapted to new climatic conditions

Climate change may lead to a slight increase in plantation yields for certain seed sources. This is a key finding of a study undertaken by researchers at the Canadian Forest Service and the ministère des Ressources naturelles et de la Faune du Québec, who set out to predict the yield from white spruce plantations growing in the conditions projected by climate change models.

It is widely recognized that tree populations are well adapted to the climatic conditions prevailing where they grow. However, climate change causes rapid changes in temperature conditions and precipitation patterns. It can take several generations for a given local population to adapt to these new conditions. Provenance tests can be useful for estimating the impact of climate change on tree populations and determining which provenances are best suited to areas requiring reforestation.

In this study, the researchers simulated the transfer of a seed source from Valcartier to other regions of the province. Under current climatic conditions, a plantation established in the Montreal area using this seed source would produce a yield similar to that of the local source. However, under the climatic conditions projected for 2070, a lower yield would be obtained. Seedlings from the same provenance planted in the Témiscouata region currently provide a higher yield than the local seed source. Tree growth would be even better under the climatic conditions projected for 2070. However, these results are based on the assumption that all biotic and abiotic factors will remain unchanged.

Photo: M.-C. Gros-Louis

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Predicting the effect of drought on tree growth

During a drought period, the soil moisture content declines. Soil moisture plays an important role in forests since it has a direct effect on tree growth and transpiration by controlling the leaves' CO_2 uptake.

Climate change could lead to an increase in the frequency and intensity of droughts in certain regions of Canada, which would have a significant impact on ecosystems. One effect would be a reduction in tree growth. However, it is difficult to incorporate this reduction in growth into climate change projection models because of the lack of empirical data on relationships between soil moisture and tree growth mechanisms.

Researchers at the Canadian Forest Service, Environment Canada, the University of British Columbia, Queen's University and the University of Zurich studied this phenomenon in two types of forest stands (trembling aspen and jack pine) in Saskatchewan. The stands are located in an area that experienced severe droughts between 2001 and 2003.

The researchers quantified the effect that soil texture has on the relationship between soil moisture content and the processes of transpiration and photosynthesis. Soil texture was found to control the soil's water retention capacity and its ability to transfer water to the root area. In addition, the researchers assessed how the importance of certain environmental variables used in predicting the physiology of tree growth varies depending on the time scale used. For example, air humidity values, which are essential for estimating photosynthesis on a daily time scale, are much less important for predictions on a monthly scale.

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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

Special Issue on Climate Change

Increase in forest fire activity by the end of the century

An increase in forest fire activity is expected to occur by the end of the 21st century. The results of a study conducted by Canadian Forest Service and Climate Risk Analysis researchers suggest that with climate change, the projected increase in precipitation will be insufficient to compensate for increasing temperatures and to maintain the evapotranspiration potential of forests at current levels.

Photo: D. Paré

It may be necessary to rethink forest management practices in light of the predicted increase in fire activity. The current trend in silviculture is to emulate the natural disturbance regime. Forest fires are important natural disturbances that shape boreal forest landscapes. If the scale of these disturbances increases, forest management will have to be aimed at reducing their impact. For example, it will be necessary to increase fire suppression activities and associated budgets, plan more post-fire salvage operations, and implement regeneration programs.

The study results also show the changes that could occur in Canadian forests based on different global warming scenarios. The statistics on forest fires over the past 50 years were used as the basis for model development. Using dendrochronological studies, the researchers also identified the main periods of drought that have occurred since the late 18st century in order to compare them with future predictions.

The model predictions show that, under the best case scenario, global warming could lead to a forest fire frequency comparable to the very high level observed in the 1780-1840 and 1920 decades. However, in all likelihood, the magnitude of the increase in forest fires activity will be much greater.

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A simulation points to reduced tree growth

Based on the results of a study conducted by researchers at the Canadian Forest Service, Université Laval and the University of Winnipeg, climate change could lead to a decrease in jack pine, black spruce and trembling aspen growth. These findings contrast with the increase in plant productivity usually projected. The researchers performed computer simulations to assess the effect of global warming on various factors that influence forest productivity.

While the growing season is expected to be longer, water availability could become a problem with climate change because of the increase in temperatures and summer drought frequency. The predicted reduction in growth does not take into account productivity losses associated with forest fires and insect outbreaks. The frequency of these types of disturbances could also increase as a result of climate change.

Photo: J. Beaulieu

An analysis of annual tree growth rings made it possible to develop a hybrid model linking annual growth to ecophysiological variables simulated by a model of the processes involved in atmospheric carbon fixation. The baseline data for the study came from the Duck Mountain Provincial Forest in Manitoba.

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The impact of climate change on forested peatlands

A study undertaken by researchers at the Canadian Forest Service and the Université du Québec en Abitibi-Témiscamingue shows that with the expected climate change, peatlands should continue to accumulate carbon if the precipitation level remains high.

In eastern Canada, peatland development may even be enhanced since the precipitation level is expected to increase. However, the drier conditions that are predicted for central and western Canada would limit the role played by peatlands in carbon sequestration. The predictions for Fennoscandia (the region encompassing Scandinavia and Finland) resemble those for eastern Canada. Due to a lack of data, it is impossible to predict what will happen to the former Soviet Union's extensive peatlands—the largest area of peatlands in the world.

Forested and non-forested peatlands cover only 4% of the Earth's land surface. In northern ecosystems, peatlands form in waterlogged areas where drainage is poor. The accumulation of sphagnum moss in these areas indicates that organic matter production exceeds its rate of decomposition. Northern peatlands account for about 30% of the world's soil carbon pool, which makes them an important factor in the current climate change issue.

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