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In Brief

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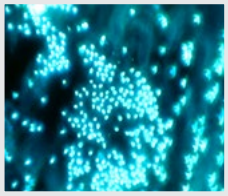


Trees are thirsty

Biomes are the largest biological communities known to exist throughout continents. Each biome is characterized by its climate, its dominant vegetation formation, its fauna and its soil types. Studies examining the effects of climate on tree growth are uncommon on a scale of this magnitude.

Researchers from the Swiss Federal Institute for Forest, Snow and Landscape Research, the Polish Academy of Sciences, the University of Arizona in the United States, the Strada Universitatii in Romania, Université du Québec à Montréal and the Canadian Forest Service have conducted a study focusing on temperate and boreal forest biomes. Their objective was to learn about tree growth responses to climatic variables and how these responses evolved during the periods spanning from 1930 to 1960 and 1960 to 1990. Consulting a global network of 2,720 sites, they were able to analyze data on climate parameters and annual growth rings in trees of the boreal and temperate forests.

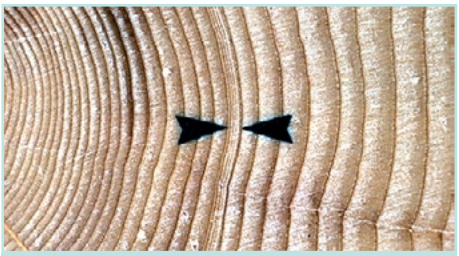

Photo: NRCan

Researchers note that drought has become the major factor hampering tree growth around the world, and particularly in Canada's boreal forest. In fact, the lack of water reduces the sugars being transported from the leaves to the stems, thus reducing the efficacy of basic physiological processes such as photosynthesis and cell division.

This dependency of tree growth on water availability may increase with the climate changes predicted within the current century.

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Deer doing forestry work on Anticosti Island

Researchers from Université Laval, the ministère des Forêts, de la Faune et des Parcs du Québec and the Canadian Forest Service examined the effects on balsam fir performance of white-tailed deer browsing on Anticosti Island. The study was conducted inside a large (11.3 km^2) enclosure that had been cut and fenced in. The deer population was decreased (15 deer/km^2) through hunting. In 2009, an experimental plantation of balsam fir seedlings was created combining the presence/absence of deer and silvicultural treatments. The deer were kept out of one half of the study area by means of mini-exclosures.

The results after seven years of growth showed that:

- the silvicultural treatments did not affect the performance or survival of the balsam fir seedlings;
- the height and diameter of the balsam fir seedlings outside the mini-exclosures were 30% smaller than those of the seedlings inside the mini-exclosures, on account of the cumulative browsing activity;
- however, the deer's selective browsing on neighbouring plants allowed balsam fir seedlings outside the mini-exclosures to reach full sunlight at a height of less than 125-146 cm, well ahead of the seedlings within the mini-exclosures (161-184 cm).

According to the researchers, the positive effects of browsing on the growth of balsam fir seedlings may substantially outweigh the benefits of silvicultural treatments. They therefore propose a target population density of no more than 15 deer/km^2.

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Genotype versus phenotype: which is more cost-effective?

A genome is defined as the complete set of genes contained in the cells of a living organism, whereas a phenotype is the totality of the organism's physical characteristics. To date, several plant genomes have been sequenced, which means that their entire DNA has been deciphered.

Photo: NRCan

The genomic selection of trees consists of interpreting the sequences and accurately choosing superior individuals for forest tree improvement programs. This technique is rapidly gaining momentum, in part to meet the growing demand for high quality wood fibre. Some of the complex characteristics of trees can be predicted based on the fingerprint of their genetic markers. The goal is to use the seeds to grow higher quality genetically improved seedlings, enabling the establishment of more productive plantations.

Researchers from the ministère des Forêts, de la Faune et des Parcs du Québec, the University of British Columbia, and the Canadian Forest Service tested genomic selection within a black spruce population in the boreal forest to identify growth characteristics and wood quality. They demonstrated that this tool can be used to accurately identify the trees which will produce select, high quality seedlings for reforestation. In addition, as compared with phenotypic selection, the costs associated with genomic selection are minimized by avoiding trial phases in the field.

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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

Travelling forest insects

Photo: NRCan

Drought, fire and insect outbreaks often cause large-scale tree mortality. This situation can have repercussions on the climate, with significant consequences regarding biodiversity and the functioning of ecosystems.

In order to better understand the relationships that exist between climate change and forest insects, researchers from the Institut national de la recherche agronomique in France, the Department of Agronomy, Food, Natural Resources, Animals and Environment in Italy, and the Canadian Forest Service reviewed the literature on this topic. They analyzed 213 articles published between 2013 and 2017, making note of the following important points.

• There is strong evidence that climate change can either aggravate or mitigate the severity of forest insect outbreaks.

• Their populations are expanding into new ranges, particularly at higher altitudes and more northerly latitudes.

• The effects of climate change are evident in the case of some species, but must not be taken as applying to all others.

• In the future, spruce beetle infestations may occur throughout the entire spruce range in North America.

• The spruce budworm may move further north, colonizing secondary host species.

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Black spruce is adapting

The study of climatic influences on the phases of seasonal development in living organisms is called phenology. It is an effective tool for monitoring tree adaptation to climate change. For black spruce, bud growth dynamics and wood formation are good indicators of its adaptation to its local environment. Observing these dynamics increases our understanding of the species' growth and adaptation mechanisms. However, it is not yet clear whether the phenological traits observed in the buds of black spruce also correspond to specific periods of radial growth (or cambial activity) and wood formation.

In order to examine this question, researchers from Université du Québec à Chicoutimi and the Canadian Forest Service compared the phenology of the cambium of black spruce trees selected from seven populations representing various regions across Quebec. These populations underwent prior classification into two groups – early budburst and late budburst. The objective: to verify whether the differences observed in bud phenology may be reflected in cambial growth.

Researchers observed that various populations of black spruce established on the same site (and therefore subject to the same environmental conditions) retain their distinct bud growth dynamics, reflecting their original local adaptations. The results also show that the dynamics of bud growth are synchronized with the dynamics of wood formation. These results help to better understand the growth and adaptation mechanisms of black spruce in a context of climate change.

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What is the Schnute growth function?

Forest ecosystem management practices focus on the use of partial cutting operations to integrate ecological, economic and social objectives. Growth model forecasts can help guide foresters in their choice of management strategies. However, after partial cutting, about 50% of the response in terms of residual tree growth remains unexplained, which hinders efforts to predict forest productivity.

There is, however, a new equation-based analytical approach, Schnute's growth function, which helps improve radial growth model predictions following partial cutting operations. This tool was used by researchers from Université du Québec à Chicoutimi, the Chinese Academy of Sciences Guangzhou Branch and the Canadian Forest Service to assess individual tree growth and identify the factors involved in the response of residual trees.

The research was carried out on six study blocks in even-aged black spruce stands in eastern Canada's boreal forest. The blocks were subjected to experimental partial cutting. With this new approach, researchers were able to explain 61 to 80% of the variation in cumulative radial growth ten years after cutting. As a result, Schnute's growth function helps support forest management strategies more effectively by improving tree growth predictions after partial cutting.

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