Natural Resources Canada | Ressources naturelles Canada

In Brief

from the Canadian Forest Service – Laurentian Forestry Centre

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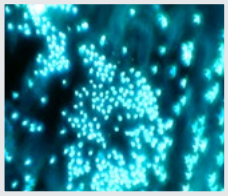


Accuracy of hemlock looper defoliation estimates

Annual estimates of defoliation by an insect pest such as the hemlock looper are based on leaf reddening captured by aerial surveys, but these are rarely validated by field data. This can lead to errors in estimating the severity of defoliation. In addition, current expertise in aerial defoliation assessments was developed by focusing on the spruce budworm specifically, an insect that mainly affects the foliage of annual shoots. However, the hemlock looper attacks not only the current year's foliage, but also that of previous years, which can lead to estimation biases.


Photo: NRCan

Researchers from Laval University and the Canadian Forest Service assessed the accuracy of defoliation classes obtained from aerial surveys, by comparing them with observations made on the ground during a recent hemlock looper epidemic. They also examined the link between the severity of defoliation of the current year's shoots and that of the foliage as a whole.

The results of the study showed that aerial surveys were fairly accurate in estimating defoliation severity during the first year of the epidemic, but that their accuracy decreased thereafter. Aerial surveys were also less accurate at both ends of the gradient of defoliation (nil or severe), even in the first year. When assessed on the ground, defoliation of the current year's shoots was an accurate estimator of overall defoliation, but this accuracy decreased with foliage age. Cumulative defoliation over all foliage age classes therefore poses a major challenge to the teams responsible for aerial defoliation inventories.

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https://scf.rncan.gc.ca/publications?id=40768

Soil sensitivity to forest harvesting residues: mapping, comparisons and challenges

Intensive harvesting of residual forest biomass can lead to soil degradation on vulnerable sites. However, little is known about the soil properties that may be linked to the degradation of these sites as a result of biomass harvesting.

Researchers from the Ministère des Ressources naturelles et des Forêts du Québec and the Canadian Forest Service tackled this issue by mapping sand content, slope and pH, as well as indicators of nutrient balances; this is a first-of-its kind research for the entire Canadian commercial forest at a resolution of 250 m (all this data and mapping is available on this LINK). Their aim was to derive robust indicators of site vulnerability to forest biomass harvesting.

The results showed a lack of consistency between site property indicators and nutrient balance indicators when it came to explaining site sensitivity to biomass removal. This illustrates the need for great caution in the selection of site sensitivity indicators and underlines the importance of improving understanding of biogeochemical cycles. Until nutrient balance models are improved, soil properties may be a preferable option for identifying sites that are sensitive to biomass removal and for developing guidelines.

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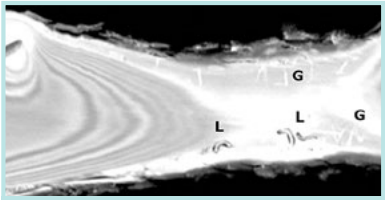
Computed tomography to detect woodborer insects

The development of the international timber trade increases the spread of insects that cause considerable economic losses in importing countries. For example, the emerald ash borer (EAB), an insect introduced to North America by wood from Asia, continues to cause significant damage to ash trees in forest and urban environments. Countries importing wood products from Canada require rigorous control to prevent the spread of insects.

Researchers at the Canadian Forest Service evaluated the effectiveness of detecting emerald ash borer and birch borer (a species native to North America) in logs using computed tomography (also known as CT scans). This imaging technique is used in medicine, oceanography, paleontology, and even to detect the black longhorn beetle in logs burned by fires.



A CT-scan image of a longitudinal section of an ash sample showing larvae (L) and their galleries (G). Photo: NRCan

The results of this research show that CT scans are effective in detecting woodborers. This study will help to provide precise recommendations on the thickness of phloem to be removed with the bark to eliminate borers present in infested logs intended for export. The use of CT scans is also promising in the manufacturing environment, as combined with artificial intelligence, insect recognition algorithms will make their detection on production lines faster and more accurate.

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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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Woodborers or salvage logging: first come, first served!

Salvage logging carried out quickly after a forest fire reduces economic losses. Woodboring insects, particularly longhorn beetles such as the white spotted sawyer, attack recently burned trees, reducing the commercial value of lumber.

Researchers from Laval University and the Canadian Forest Service have developed a model to predict the colonization rate of black spruce and jack pine by longhorn beetles after a fire. Using a remote sensing method to estimate burn severity, they measured the relationship between the probability of finding longhorn beetle boreholes and their density as a function of burn severity. Other readily available indicators, such as hardwood basal area and softwood stem diameter, can be used to predict longhorn beetle attacks.

Photo: NRCan

Results show that in black spruce, the probability of finding longhorn beetle boreholes and their density followed a bell-shaped relationship with fire severity, reaching maximum values in areas of moderate severity. In jack pine, the probability of finding boreholes increased with fire severity and stem diameter. This research on longhorn beetle attack prediction models have been developed to help forest managers plan post-fire salvage logging activities.

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Exotic earthworms: a presence with impact

Photo: NRCan

Non-native earthworms have been invading North America since European colonization. Although there is much research available regarding non-native earthworms, they remain a potential threat to the integrity of boreal ecosystems, particularly in terms of soil carbon storage. Researchers from the University of Alberta and the Canadian Forest Service conducted a study to determine the impact of earthworm invasion on morphological characteristics and carbon storage in different soil types in the Canadian boreal forest.

The findings revealed a decrease in most cases in the thickness of the organic layer with the loss of humus in soils invaded by earthworms. At the same time, earthworms reworked the surface mineral soil to form a new soil horizon characterized by an enrichment in organic matter and excreta. Carbon stocks in the organic layer decreased for Luvisols and Brunisols, but remained unchanged for Podzols. The mineral soil carbon stock for Brunisols was increased in the presence of earthworms, while no change was observed for Luvisols and Podzols. These results demonstrate the significant impact of invasive earthworms on soil morphological characteristics and carbon stocks in the boreal forest.

While carbon stocks were less affected in the mineral soil than in the organic layer, the development of a new superficial horizon reworked by earthworms could alter microbial dynamics and influence carbon persistence.

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Aerial monitoring of white spruce seedling phenology

Phenology, or the study of seasonal variation in biological processes, represents a reliable indicator of tree response to the consequences of climate change. Phenological monitoring of photosynthesis, for example, makes it possible to identify the effect of climate change on the physiology and subsequent development and growth of trees. In conifers, remote sensing tools based on chlorophyll reflectance were not effective for such large-scale monitoring, due to the limited changes in this pigment in conifer foliage during and outside the growing season.

In search of a more effective approach, scientists from the University of Toronto and the Canadian Forest Service evaluated the effectiveness of various spectral indices including carotenoid chlorophyll index (CCI), a type of leaf pigment sensitive to seasonal variations of photosynthetic activity in conifers. These indices were obtained using a drone equipped with a multispectral camera to monitor the phenology of photosynthesis for an experimental population of 6,000 seedlings from 2,000 white spruce genotypes. The CCI proved sensitive to seasonal variation in photosynthetic activity between trees, thanks to the close link between photosynthesis and foliage carotenoid content. This approach offers considerable savings in measurement time and in the number of individuals measured. This will speed up the selection of tree genotypes that are resilient to the effects of climate change.

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