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In Brief

from the Canadian Forest Service – Laurentian Forestry Centre

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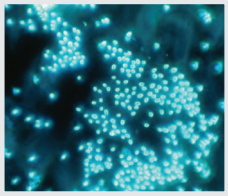


Decline in spruce budworm outbreaks related to defoliation of stands

Photo: T. Arcand

Four spruce budworm (SBW) populations were studied over a 15-year period by Canadian Forest Service researchers in Quebec and Ontario.

Decreased density of SBW populations and the decline in outbreaks are closely related to the survival of the insects during the final larval stages. This reduced survival of larvae is mainly attributable to the impact of natural enemies, such as parasitoids or natural pathogens. The researchers also observed that the annual defoliation had a negative influence on the fecundity and survival of larvae during the final larval stages. These observations confirm facts that were already fairly well known.

However, the researchers discovered that several consecutive years of severe defoliation of stands resulting from a prolonged outbreak have a highly adverse effect on the survival of insects during the first two larval stages and thus affect the course of the outbreak. This previously unknown impact results from the high mortality rate that can be caused by the behaviour of these insects in their larval stages, when they are passively dispersed (borne on the wind) from tree to tree. This behaviour is triggered by the search for hibernation sites in the late summer or for feeding sites in the following spring.

The findings of this study reiterate the importance of considering the interaction between budworm populations and the conditions of affected forest stands and will lead to the development of a more accurate mathematical model of the behaviour of populations of this insect.

For information: Jacques Régnière, jacques.regniere@nrcan-rncan.gc.ca

Abitibi Clay Belt - Adapting forest practices to maintain the biodiversity and productivity of forests

In the forest ecosystems of the Abitibi Clay Belt, it is necessary to use partial cutting methods in order to leave residual forest on the land with an open structure similar to that of old-growth forests. It is also necessary to further disperse the logged areas, preserve portions of residual forest and, in order to maintain tree growth, choose more aggressive soil preparation methods that help reduce the thickness of the organic layer of the soil.

Canadian Forest Service researchers in co-operation with colleagues at the Université du Québec à Montréal and the Université du Québec en Abitibi-Témiscamingue compared the action of forest fires with that of forest practices on the forested lands of the Abitibi Clay Belt and northeastern Ontario. As in all boreal forests, the major disturbances of forest fires have shaped these ecosystems. By using the impact of the fire regime as a model, it could be possible to maintain productive ecosystems and preserve their biodiversity.

With a 140-year fire cycle, as exists in the Abitibi region, 54% of the forests would theoretically be more than 100 years old and 15% would be over 200 years old. However, current forest practices are eliminating old-growth forests, whereas forest fires have a tendency to create larger regeneration areas that are better distributed over the entire territory, while naturally sparing certain portions within their perimeter. Forest fires also make it easier to maintain forest productivity because they reduce the thickness of the layer of organic matter, unlike harvest with advance regeneration protection (HARP) cutting, which does not significantly disturb this organic layer and thus contributes to lower site productivity. To offset this effect, practices that disturb the soil, such as controlled burning, are suggested.

For information: Sylvie Gauthier, sylvie.gauthier@nrcan-rncan.gc.ca

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

Boreal forest - Logging does not imitate the effects of forest fires on soil fertility

Although fire is the principal agent of boreal forest regeneration in eastern Canada, more and more sites regenerate themselves after logging. Such a change in the type of disturbance can have an effect on soil fertility. Canadian Forest Service researchers in co-operation with colleagues at the University of Alberta, University of Saskatchewan and Université Laval have studied the differences, 15 to 20 years following the disturbance, between two harvesting processes (whole tree harvesting and stem only harvesting) and forest fires. They analyzed their effects on nutrient pools, acidity and organic matter in the soil in order to assess the extent to which the impacts of logging are within the natural range of variations created by fires in coniferous stands of the Upper Mauricie region.

One of the study's findings was that logging, regardless of the harvesting process used, had created soil fertility conditions that were clearly less favourable than those created by forest fires, along with lower concentrations of nutrients and higher acidity. Compared with logging, forest fires are characterized by sudden deposits of ashes that are rich in base cations (such as calcium and magnesium) and carbonized organic matter that increase the soil's capacity to retain base cations. Forest fires therefore make it possible to build a large nutrient pool that the new stand can use throughout its development.

In many projects, the periodicity and spatial patterns of boreal forest fires have been documented in order to develop forest management models based on this type of natural disturbance. However, forest fire characteristics are not limited only to their area, spatiality and return interval. This study demonstrates that the biogeochemical processes associated with forest fires and their beneficial effects on soil are not directly imitated by logging, even when the stem-only harvesting method, which is considered more sustainable than the whole-tree harvesting method, is used.

For information: Evelyne Thiffault, evelyne.thiffault@nrcan-rncan.gc.ca

Hemlock loopers on Anticosti Island - An example of adaptation to the climate and to balsam fir

In a study conducted in the laboratory, Canadian Forest Service, Université Laval and Université de Montréal researchers compared the biological performance of a population of hemlock loopers on the mainland with that of a population of hemlock loopers on Anticosti Island. Insects in both locations were raised on balsam fir, hemlock and sugar maple. Hemlock loopers can feed on several coniferous and hardwood species, but on Anticosti Island, hemlock and sugar maple are absent from the environment. Nonetheless the Anticosti Island population is capable of surviving on these species when forced to feed on them. However, many larvae go through an additional larval stage and perform less well than they do on fir trees, which is not the case for the mainland population.

Photo: T. Arcand

Because of the short summers on Anticosti Island, hemlock loopers must develop and reach adulthood more quickly. On balsam fir, the larvae go through four larval stages, compared with five on the mainland. Climate therefore appears to be a major natural selection factor for this species.

The hemlock loopers on Anticosti Island form a particular geographic biotype, compared with the mainland populations. Their capacity to adapt to fir trees and their vital four-larval-stage cycle are elements that may explain the high recurrence of hemlock looper outbreaks on Anticosti Island.

For information: Christian Hébert, christian.hebert@nrcan-rncan.gc.ca

Forest ecosystem management in boreal forests - Using natural disturbances as a model

Forest activities and forest fires are two disturbances that together rejuvenate Canada's boreal forests. In order to practise sustainable forest management, it is necessary instead to use a forest ecosystem management approach that should be modelled on the principal natural disturbances of forest fires, insect outbreaks and windfall. For Canada's boreal forests, it is forest fires, in particular, that shape the land. The fire regime, the percentage of burned forest and the distribution of burned forest per major unit of territory are the variables to take into consideration.

Researchers at the Canadian Forest Service, Université du Québec à Montréal, Université du Québec en Abitibi Témiscamingue and Simon Fraser University in British Columbia used the available information on the fire regimes of various regions to assess the maximum sizes that logged areas should attain and the distances to be maintained between logged areas based on the region's fire regime. They found that the longer the fire cycle, the greater the distance between harvest agglomerations should be. For example, in order to maintain the ecological functions of the forest landscapes of northwestern Quebec over the long term using an ecosystem approach, it would be necessary not only to make provision for large regeneration areas, but also to increase the distance between them in order to preserve large mature forest tracts between the logged areas. The researchers' publication contains diagrams used to define these two elements for various fire regimes that are characteristic of the Canadian boreal forest.

For information: Sylvie Gauthier, sylvie.gauthier@nrcan-rncan.gc.ca

For more information about the series:
Natural Resources Canada
Canadian Forest Service
Laurentian Forestry Centre
1055 du P.E.P.S.
P.O. Box 10380 Stn. Sainte-Foy
Quebec (Quebec) G1V 4C7
418 648-5789

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