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Branching Out
from the Canadian Forest Service - Laurentian Forestry Centre

PREDICTING INSECT ATTACKS TO BETTER PLAN POST-FIRE SALVAGE LOGGING OPERATIONS

Fire is a major disturbance in the boreal forest. It stands out from other natural disturbances due to its ability to instantly generate massive quantities of deadwood over a large area. These dead trees are rapidly colonized by numerous saproxylic insects that depend on deadwood for part of their lifecycle, including longhorn beetles and other woodboring insects. Considering climate change and Canada's unprecedented forest fire season of 2023, salvaging burned timber can help maintain a certain level of wood supply for the forest industry, thus reducing financial losses.

A number of recent studies have shown that it is possible to predict post-fire woodboring insect attacks and reconcile salvage logging with the protection of forest biodiversity through sustainable forest management.

Costly attacks

Forest fires have a negative financial impact, not only because they reduce the volume of available wood and the future growth of trees, but also because they facilitate the colonization of burned trees by woodboring insects, which rapidly diminishes the market value of salvaged wood. In fact, after a fire, the subcortical tissues of burned trees retain their nutritional value for many wood-boring insects, including the Whitespotted and Northeastern pine sawyer beetles. Though, the galleries dug by the larvae of these insects reduce the economic value of sawn lumber.

Conservation concerns and salvage logging

Fires generate unique conditions for many saproxylic species that thrive on burned timber. Salvage logging can affect the abundance and species richness of many wood-dwelling insects, particularly longhorn beetles, which in turn are an important source of food for other animals such as the black-backed woodpecker. By significantly removing resources vital to the maintenance of this distinctive entomofauna in burned forests, salvage logging has raised significant biodiversity conservation concerns. Recent scientific knowledge on the conditions leading to the colonization of burned trees by beetles have proved invaluable in identifying the preferences of these species and better plan salvage logging, while protecting biodiversity of burned forests.

▲ *Entry (oval) and exit (round) holes bored by the Whitespotted sawyer beetle in a tree burned a few years ago.*

Background photo : burned black spruce stand.

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Forest biodiversity • Fire is a crucial ecological process and burned forests play an essential role in maintaining biodiversity. Certain saproxylic beetles, including wood-boring species, are well adapted to and even associated with recurring fires, and increase their populations significantly after a fire by efficiently utilizing these new habitats. Birds such as the black-backed woodpecker benefit from the sudden abundance of these insects as a food source. In addition, these woodboring insects contribute to nutrient cycles and energy flows by playing an important role in the decomposition process of deadwood, providing vital ecological services for forest productivity.

Thinking like a beetle

Researchers at the Canadian Forest Service have helped demonstrate that it is possible to predict beetle attacks based on a limited number of variables. The most significant is burn severity, which is strongly linked to fire intensity, i.e., the level of energy released by the flaming front of the fire. Burn severity measures the short- and long-term impact of a fire on the burnt environment. The differenced Normalized Burn Ratio (dNBR) index obtained from Landsat satellite imagery is designed to determine and map burn severity. Researchers tested this approach in Quebec's Haute-Mauricie region, focusing on forest stands dominated by black spruce and jack pine.

▲ *Sawdust under bark expelled by the Whitespotted sawyer beetle as it digs and cleans its gallery.*

Mapping burn severity helps to predict the geographical distribution of longhorn beetle damage in burned forests. This helps better plan salvage logging and site restoration operations in a shorter timeframe than with in situ data, which are often difficult to access and costly to obtain.

Predicting longhorn beetle attacks is particularly important, since these insects rapidly colonize burned areas within days or even hours after a fire, causing damage in the immediate aftermath. Moreover, higher summer temperatures, especially in burned areas, accelerate the progress of these insects, particularly in the case of black spruce.

Other studies on the preferences of woodboring insects provide greater insight into their spatial distribution and post-fire succession. For example, studies have shown that certain beetles colonize black spruce in greater abundance than jack pine. One study in particular highlights the significance of proximity to unburned forests as a factor influencing insect colonization. This research has helped to identify areas of high biodiversity value and put forward recommendations for their maintenance.

New scientific findings and tools help to better predict the presence and abundance of woodboring insects after a fire. As a result, when planning salvage logging operations, more informed decisions regarding intervention and conservation priorities can be made. These insights are vital to developing post-fire salvage strategies that incorporate biodiversity concerns and take full advantage of the window when salvaging is most profitable. Since 2021, the Government of Quebec has applied the longhorn beetle prediction model to map the post-fire presence and abundance of their galleries, indicating potential loss for the sawmill industry. One of the challenges of future research will be to continually improve predictive models in a complex and changing world.

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